OPERATION MANUAL

MICROWAVE RADIO TEST SET

ME645A

SUPPLIER: ANRITSU AMERICA, INC.

MANUFACTURER: ANRITSU ELECTRIC CO., LTD.

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Caution 1: *The Displaying Unit and Sending Unit are adjusted in combination with their own ancillary equipments below.*

1. *IF POWER HEAD*
2. *RF POWER HEAD*
3. *DIRECTIONAL DETECTOR*
4. *RF RETURN LOSS BRIDGE (SP-2369)*

The Anritsu serial numbers of these ancillary equipments meet with those of Displaying Unit and Sending Unit. At measurement, check that the serial numbers are the same between the four ancillary equipments and Displaying/Sending Units.

If the ancillary equipments of different serial numbers are combined with Displaying Unit and Sending Unit, the error may increase, and the required measuring accuracy may not be obtained.

Caution 2: *If the power cord is pulled out by accident and connected again or the instantaneous commercial source failure occurs while power switch is turned on, Sending Unit may sometimes not be restored to the normal condition. In such case, turn the power switch off once and on, then the Sending Unit will operate normally again.*

Options:

The following options are available for this ME645A.

- Option 001: 11GHz capability
- Option 002: Direct RF counting
- Option 003: 2GHz capability
- Available Ancillary Equipment (See Table C)

OPERATION MANUAL FOR

MICROWAVE RADIO TEST SET

ME645A

1. GENERAL

1.001 This addendum supplements ASAC-104-201-501, Issue 2.

1.002 This addendum is issued for the following reason.

(a) To add a caution in Caution Sheet (Yellow) so that Sending Unit can be stably operated.

1.003 Issue 1 of this addendum was issued to change the specification of Frequency Counter. (required by AT&T)

2. CHANGES TO SECTION

ISSUE 1 CHANGES

2.001 On Page 1-13, Table D, 4 GHz band of item 8 (13), change 3.65 GHz to 3.5 GHz.

2.002 On Page 2-11, Fig. 13, change RF INPUT frequency panel indication from 3.65 GHz to 3.5 GHz.

2.003 On Page 3-6, subparagraph C (a), change 3.65 GHz to 3.5 GHz.

ISSUE 2 CHANGES

2.004 Designate the original caution as Caution 1.

2.005 Designate this additional caution as Caution 2, and add the following:

Caution 2: ***If the power cord is pulled out by accident and connected again or the instantaneous commercial source failure occurs while power switch is turned on, Sending Unit may sometimes not be restored to the normal condition. In such cases, turn the power switch off once and on, then the Sending Unit will operate normally again.***

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SECTION 1

GENERAL INFORMATION

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1. INTRODUCTION

1.01 This operation manual contains all the information necessary to operate the Microwave Radio Test Set (MRTS) ME645A. Calibration, adjustment, trouble-shooting, repair and replaceable parts are covered in the separate Service Manual.

A. FEATURES

1.02 The MRTS is designed to meet the requirements of AT & T Company. Principal measurement items are power, frequency, amplitude response, return loss, noise figure, IF spectra, carrier resupply, fade margin, and DC voltage.

1.03 The MRTS has the following special features:

1.04 *Versatile Capabilities:* Most measurements can be made at the repeater site of a microwave relay system.

1.05 *Easy Operation:* In most cases the measurement item can be switched by merely pushing a single function switch for the desired item.
The power meter uses autoranging.
The RF sweep generator center frequency is set by thumb wheel switch.
The IF and RF sweep generator sweep width is selected in one operation.

1.06 *High Accuracy:* The power meter has a 4 digits digital indicator. The sensor is calibrated by an internal reference oscillator. The PCD in the IF sweep generator and the PLL in the RF sweep generator assure accurate, stable output frequencies.
The CW frequency and ΔF mode IF and RF source frequency markers are controlled by crystal oscillators.

* PCD: Pulse Counted Discriminator
PLL: Phase Lock Loop

1.07 *Alarm Signs:* When the controls, push button and adjusters are manipulated by an inproper procedure or misoperation an alarm signs (blinking of the LED Display or red lamp) tells that to the operator.

1.08 *Simple Construction:* The main units are the DISPLAYING UNIT and SENDING UNIT.
These units are connected by interface cable.

1.09 *Portable:* The compact size and light weight make the test set suitable for hand-carrying and transport by helicopter.

1.10 *High Reliability and Ruggedness:* ICs and LSIs are used extensively throughout to reduce the number of components to a minimum. The selection of parts having small failure rates increases reliability. A rugged mechanical designing is used throughout, considering the most severe transportation conditions.

1.11 *Microprocessor:* The internal microprocessor assures easy operation, high accuracy, and high reliability.

2. CONFIGURATION

A. Basic Configuration

2.01 MRTS ME645A for 4 and 6GHz band is the basic equipment, the units of which are listed below:

Table A—Basic Configuration

Description	Q'ty
Displaying Unit	1
Sending Unit	1
Furnished Ancillary Equipment	1 set

2.02 Furnished Ancillary Equipment List is as follows.

Table B—Furnished Ancillary Equipment List

No.	Descriptions	Q'ty	Model No. or Part No.
1	IF Power Head, 10 to 300MHz, 75Ω WECo 440*	1	IF POWER HEAD
2	RF Power Head, 0.1 to 11.7GHz, 50Ω, Type N(M)	1	RF POWER HEAD
3	Directional Detector, 3.65 to 11.7GHz	1	DIRECTIONAL DETECTOR
4	Coaxial Low Pass Filter, 4GHz, Type N(M-F)	1	MA62A
5	Coaxial Low Pass Filter, 6GHz, Type N(M-F)	1	MA63A
6	Leveling Cable Assembly A	1	FA6
7	Cable, BNC(M) to BNC(M) 2.5m	1	FA7-1
	Cable, BNC(M) to BNC(M) 0.13m	1	FA7-2
8	Power Head Cable (IF) black 2.5m	1	FA8-1
	Power Head Cable (RF) green 2.5m	1	FA8-2
9	Cable, WECo 440* to WECo 440* 2.5m	2	FA9
10	AC Power Cord yellow 7'6"	1	
11	Interface Cable between Displaying Unit and Sending Unit	1	FA11
12	Instruction Manuals (Operation Manual and Service Manual)	1 ea.	
13	P.C. Board Removal Tool	2	
14	Self-contained Card Extender	1 set	
15	Fuse (5A)	1	
16	Fuse (0.5A)	1	
17	Secondary Fuse (10A ... 2, 1.6A ... 3, 2A ... 1)	1 set	

Note: *WECo 440 or Equivalent.

B. Options

2.03 In addition to the basic MRTS ME645A, the following options are available:

(1) *Option 001:* Conversion to add 11GHz capability
The addition of the 11GHz band is possible both in the original order or on a retrofit basis.
Furnished Ancillary Equipment for option 001: Coaxial low pass filter, 11GHz, Type N(M-F), MA71A.

(2) *Option 002:* Direct RF counting
Direct RF counting can be included only in the original order.

(3) *Option 003:* Conversion to add 2GHz capability
The addition of the 2GHz band is possible both in the original order or on a retrofit basis.
Furnished Ancillary Equipment for option 003:

a. Directional Detector (2GHz)

b. Coaxial low pass filter, 2GHz, Type N(M-F), MA64A

(4) *Available Ancillary Equipment:* The available ancillary equipment list is shown in Table C.

Table C—Available Ancillary Equipment (Optional Accessories)

No.	Description	Q'ty	Model or Part No.	Note
1	RF Coaxial Attenuator, 10 ±0.5dB, 2W, DC to 11.7GHz, VSWR<1.25, Type N(M-F)	1	757C-10	A
2	RF Coaxial Attenuator, 20 ±0.5dB, 2W, DC to 11.7GHz, VSWR<1.25, Type N(M-F)	1	757C-20	A
3	RF Coaxial Attenuator, 30 ±1dB, 2W, DC to 11.7GHz, VSWR<1.25, Type N(M-F)	1	757C-30	A
4	RF Coaxial Attenuator, 20 ±0.75dB, 20W, DC to 6.5GHz, VSWR<1.3, Type N(M-F)	1	768-20-SP	A
5	RF Coaxial Attenuator, Continuously variable 0 to 20dB, 3.65 to 6.5GHz, Type N(M-F)	1	793FM-SP	A
6	IF Coaxial Attenuator, 3 ±0.3dB, DC to 95MHz, WECo 560* to 440*	1	MP531E	A
7	IF Coaxial Attenuator, 5 ±0.3dB, DC to 95MHz, WECo 560* to 440*	1	MP531F	A
8	IF Coaxial Attenuator, 10 ±0.3dB, DC to 95MHz, WECo 560* to 440*	1	MP531A	A
9	IF Coaxial Attenuator, 15 ±0.3dB, DC to 95MHz, WECo 560* to 440*	1	MP531B	A
10	IF Coaxial Attenuator, 20 ±0.5dB, DC to 95MHz, WECo 560* to 440*	1	MP531G	A
11	IF Coaxial Attenuator, 35 ±1dB, DC to 95MHz, WECo 560* to 440*	1	MP531H	A
12	IF Cable, WECo 358* to 440*, 2.5m	2	AA12	A
13	IF Cable, WECo 440* to BNC(M), 2.5m	1	AA13	A
14	IF Cable RG188A/U, WECo 440* to SEALECTRO P/N 52-024-0000, 2.5m	1	AA14	A
15	RF Cable, Type N(M) to Type N(M), 2.5m	2	AA15	A
16	Adapter, WECo 358* to 560*, Return Loss≧40dB	1	MP533A	A
17	Adapter, WECo 477* to 560*	1	MP537A	A
18	Adapter, WECo 560* to 560*	1	MA58A	A
19	Adapter, Type N(M) to WECo 560*, (Used for IF Power Head Calibration)	1	MA411A	A
20	Adapter, Type N(F) to Type N(F)	2	77	A
21	Adapter, Elbow, Type N(M) to Type N(F)	1	N-LA1014	A
22	Transition, Type N(F) to WR229 Waveguide, VSWR<1.04, 4GHz band	2	B40M-NA	A
23	Transition, 7mm connector to WR229 Waveguide, VSWR<1.02, 4GHz band	1	B40M-7A-SP	A
24	Transition, Type N(F) to WR159 Waveguide, VSWR<1.04, 6GHz band	2	D40M-NA	B
25	Transition, 7mm connector to WR159 Waveguide, VSWR<1.02, 6GHz band	1	D40M-7A-SP	B
26	Transition, Type N(F) to WR90 Waveguide, VSWR<1.04, 11GHz band	1	X40L-NA	C
27	Transition, 7mm connector to WR90 Waveguide, VSWR<1.02, 11GHz band	1	X40L-7A-SP	C
28	Filter 70MHz Band Pass, WECo 440* to 560* Insertion Loss 35dB (50MHz) 3dB (61MHz) 1.2dB (70MHz) 3dB (79MHz) 35dB (90MHz) Return Loss>26dB (64 to 76MHz, 75Ω)	1	MA49A	A
29	Filter 70MHz Low Pass, WECo 440* to 560* 61MHz Pass, 70MHz Suppress>60dB, 79MHz Reject>14dB	1	MA410A	A
30	Filter 74.1MHz Band Pass, WECo 440* to 560* Insertion Loss 35dB (54.1MHz) 3dB (65.1MHz) 1.2dB (74.1MHz) 3dB (83.1MHz) 35dB (94.1MHz) Return Loss>26dB (68.1 to 80.1MHz, 75Ω)	1	MA49B	D
31	Filter 74.1MHz Low Pass, WECo 440* to 560* 65.1MHz Pass, 74.1MHz Suppress>60dB, 83.1MHz Reject>14dB	1	MA410B	D
32	Filter Low Pass, Pass Band (0.5 to 0.7GHz, VSWR<1.17, Loss<1.5dB) Stop Band (1 to 1.4GHz, Loss>40dB), Type N(M-F)	1	MA56A	E
33	Filter Low Pass, Pass Band (0.7 to 1GHz, VSWR<1.17, Loss<1.5dB) Stop Band (1.4 to 2GHz, Loss>40dB), Type N(M-F)	1	MA57A	E
34	IF Amplifier, 35 to 45dB adjustable, 55 to 95MHz, Flatness<0.3dB, Po (Max.)>+5dBm with 3m DC Cable, WECo 560* to 560*	1	MA48A	A
35	IF Return Loss Bridge, 55 to 90MHz, Bridge Balance>55dB, Test port WECo 440*	1	MR54A	A
36	RF Return Loss Bridge, 2 to 12GHz, Directivity>44dB, Test port APC-7	1	SP2369	A
	Fixed Short, (for RF Return Loss Measurement Calibration)	1	5230	A
	Adapter, 7mm to Type N(M), (for RF Return Loss Measurement)	1	34AN50	A
37	Test Lead for D.V.M., Dual banana plug to alligator clip and pick	2	AA37	A
38	Splitting Pad 75Ω, Loss 6dB nominal, 50 to 95MHz, Connectors three WECo 560*	1	MA59A	A
39	Portable Test Rack, Displaying Unit and Sending Unit are stacked	1	MB23A	A or G
40	Soft Pack Carrying Cases, for Displaying Unit-1, for Sending Unit-1, for Auxiliary Equipment-1	3		A
41	Protective Shipping Cases, for Displaying Unit-1, for Sending Unit-1, for Auxiliary Equipment-1	3		F
42	IF Harmonic Filter, WECo 440* to 560*, Pass Band (70 to 74.1MHz, Loss<0.5dB, Return Loss>30dB), Stop Band (140 to 148.2MHz, Loss>40dB)	1	MA510A	A

Note

A: To be provided with all orders for the ME645A.
B: To be provided with orders for stations with TH-1, TH-3 and AR-6.
C: To be provided with orders for stations with 11GHz equipment.
D: To be provided with orders for TH-1 and AR-6.
E: To be provided with orders for TD-3, early vintage.
F: To be provided as requested.
G: To be provided as requested.
*: WECo 560, 440, 358, 477 or Equivalent.

3. SPECIFICATIONS

Table D—Specifications

1. POWER METER	
(1) Absolute Measurement Accuracy	Within ±0.5dB, when using the 75Ω power head over the range 10 to 300MHz or the 50Ω power head over the range 100MHz to 11.7GHz, including the effects of ancillary equipment.
(2) Accuracy of Power Meter Alone	Within ±0.2dB
(3) Harmonics	Capable of maintaining its accuracy when measuring power at +10dBm in the presence of second harmonics down 12dB from the measured signal. RF band (50Ω) with low pass filter: 500 to 700MHz 700 to 1000MHz 2.11 to 2.18GHz 3.65 to 4.25GHz 5.8 to 6.5GHz 10.6 to 11.7GHz IF band (75Ω) with low pass filter: 70MHz and 74.1MHz
(4) Range	+10 to –30dBm without external pads or amplifiers.
(5) Resolution	0.01dB
(6) Overload Rating of the Power Head	Capable of withstanding continuously +20dBm without burnout or change in characteristics.
(7) Power Head Marking	Marked as to the maximum average power the power head are capable of withstanding without burnout or change in characteristics. Displaying unit: "+20dBm MAX" Power head: "CAUTION-MAX INPUT POWER +20dBm"
(8) Readout	Digital: A 4 digit LED display in dBm. Analog: 12dB full scale (calibrated in 0.5dB increments) peaking meter.
(9) Stability	Maximum drift of ±0.1dB for +10 to –25dBm and ±0.15dB for –25 to –30dBm, over a 2 hour period at 24°C room temperature.
(10) Drift Correction	Automatic with front panel pushbutton.

Table D (Cont)

(11) IF Power Head Return Loss (75Ω)	
14 to 50MHz	no less than 25dB
50 to 95MHz	no less than 30dB
95 to 300MHz	no less than 20dB
(12) RF Power Head Return Loss (50Ω)	
0.1 to 11.7GHz	no less than 20dB without filter
2.11 to 2.18GHz 3.65 to 4.25GHz 5.8 to 6.5GHz	no less than 23dB without filter
500 to 700MHz 700 to 1000MHz 2.11 to 2.18GHz 3.65 to 4.25GHz 5.8 to 6.5GHz	no less than 15dB with filter
10.6 to 11.7GHz	no less than 13dB with filter
(13) Response Time	Within 2 seconds after applying the input power to be measured.
(14) Spurious Signals	The power meter and head do not introduce AC or DC signals into the circuit being measured.
(15) Calibration Signal	The IF calibration source is energized or de-energized independent of any meter calibration through front panel CAL and rear panel CAL power Switch, ON and OFF push-button switches.
(16) Swept Amplitude Response Range of Power Head (Oscilloscope display only)	IF band: +12 to −12dBm RF band: +10 to −10dBm
(17) Detector Flatness (Power head acting as detector)	
Frequency Band *	Transmission Flatness for up to +10dBm
IF: 50 to 95MHz	± .025dB
RF: 2.11 to 2.18GHz	± .025dB
RF: 3.65 to 4.25GHz	± .025dB
RF: 5.8 to 6.5GHz	± .025dB
RF: 10.6 to 11.7GHz	± .05dB

* Requirements to be met over any 40MHz segment.

Table D (Cont)

(18) Detector (Power head) Harmonic Distortion	The IF detector flatness is less than ±0.03dB/±20MHz with second harmonic distortion 25dB below the measured signal (with low pass filtering for RF).
2. DIGITAL VOLT METER	
(1) Ranges	±0.1 to ±100VDC and ±100 to ±999VDC
(2) Accuracy	±0.3V on 100V range and ±3V on 999V range.
3. RETURN LOSS CIRCUITRY	
The return loss is measured combination with IF and RF Return Loss Bridges.	
(1) Ranges (oscilloscope display only)	
IF (75Ω)	0 to 20dB 10 to 30dB 20 to 40dB
RF (50Ω)	0 to 20dB 10 to 30dB
(2) Test Signal Power	
IF (75Ω)	–10dBm nominal
RF (50Ω)	–5dBm nominal
(3) Accuracy	IF R.L. measurement accuracy is (for test terminal of WECo 560–without adapter): within 1dB for 10 to 30dB R.L. within 2dB for 0 to 10dB R.L. and 30 to 40dB R.L. Return loss of adapter WECo 358 to WECo 560 (MP533A) is more than or equal to 40dB. RF R.L. measurement accuracy is within 3dB for up to 25dB and visible on the display for up to 30dB.
4. SPECTRUM ANALYZER	
(1) General Requirement	Provides a visual indication of the spectra of the total IF bands of fo ±32MHz with a dynamic range of over 70dB.
(2) Scan Width Selection IF Bands (fo = 70MHz & 74.1MHz. fo is centered on display)	±1MHz ±5MHz ±15MHz ±32MHz

Table D (Cont)

(3) Dynamic Range	70dB (±1MHz) 60dB (all other scan widths) 10dB sensitivity/cm of deflection
(4) Spurious	–60dBm (all scan widths except ±32MHz; Spurious at ±32MHz is –50dBm)
(5) Reference Selection	0dBm only
(6) XY Plotter Output	Compatible with existing Baseband Analyzer (S/A)
(7) Input Buffer Amplifier	Limits L.O. Leakage out at Input Port
(8) Sweep Speed	10ms/cm
5. DISPLAY CIRCUITRY	
(1) Vertical External Input	BNC Connector
(2) Common Mode Rejection	At least 50dB on vertical external input
(3) Vertical Sensitivity (a to d)	
(Type of Signal Input)	dB sensitivity per cm of deflection
a. IF (Detected)	0.05, 0.1, 0.5 and 1.0dB
b. RF (Detected)	0.1, 0.5 and 1.0dB
c. RF & IF Return Loss	2.5dB
d. External DC (Detected)	50mV/cm of deflection
(4) Vertical Bandwidth	Fixed at DC to 10kHz and no less than 310kHz for the external input.
(5) Input Network (both Vertical and Horizontal)	1MΩ (±10%) shunted by not more than 50pF.
(6) Horizontal External Input	BNC connector; single ended DC Coupled such that a positive going voltage causes beam deflection to the right.
(7) Horizontal Sensitivity (including external input)	Adjustable over the range from 0.5V to 2.0V per cm.
(8) Blanking	Blank on an external +3V pulse, regardless of intensity (TTL compatible)
(9) Z – Axis	BNC Connector accessible from the rear panel.

Table D (Cont)

(10) Out of Range Indication	Bright line display on CRT and LED (Vertical Sensitivity) lamp blink on and off when the power head input level is from –13 to –39.99dBm ±0.2dB.
(11) Horizontal Axis	Divided into 10 equally spaced 1cm divisions.
(12) Vertical Axis	Divided into 8 equally spaced 1cm divisions.
(13) Faceplate	Shatterproof safety-shield.
(14) Bezel	Accommodates camera adapters from major scope camera suppliers such as HP Models CO1-10369A, 10369A and 197A and Polaroid CU-5.
6. RF SWEEP GENERATOR	
(1) CW Mode	2GHz band: 2.11 to 2.18GHz (option 003) 4GHz band: 3.65 to 4.25GHz 6GHz band: 5.8 to 6.5GHz 11GHz band: 10.6 to 11.7GHz (option 001) (50Ω output impedance)
(2) Frequency Setting Accuracy	Within $\pm 1 \times 10^{-5}$
(3) ΔF Sweep Mode	Fixed sweep width sweep width: ±2, ±10, ±15, ±20MHz
(4) Leveled Power Output	Continuously adjustable over the following ranges: 0dBm to +10dBm (2, 4, 6GHz bands) 0dBm to +5dBm (11GHz band)
(5) Cable (RF Oscillator to Directional Detector)	Cable assembly is encased in a common sheath.
(6) Power Output Continuity	The Power Output does not vary more than 0.2dB when switching from a swept mode to the CW mode. in 2 and 4GHz bands, ΔF = ±10MHz in 6GHz band, ΔF = ±15MHz in 11GHz band, ΔF = ±20MHz
(7) Power Output Stability	Within ±0.05dB over any 15 minute interval and within ±0.1dB over any continuous 24 hour period.

Table D (Cont)

(8) Power Output Flatness	Frequency Band / Output Power / Output Flatness 2 and 4GHz bands / 0 to +10dBm / ±0.025dB/±10MHz 6GHz band / 0 to +10dBm / ±0.025dB/±20MHz 11GHz band / 0 to +5dBm / ±0.05dB/±20MHz
(9) Sweep Frequency	46Hz nominal
(10) Sweep Linearity	Within ±2.5% of the sweep width
(11) RF Frequency Markers	One pair of markers for each of the sweep modes, switch selectable in increments of 1MHz from 0 to 20MHz.
(12) RF Frequency Markers Accuracy	Within ±0.005%
(13) RF Generator Frequency Stability (a to d)	
a. With temperature	Maximum change in frequency is:
2 and 4GHz bands	±160kHz/°C from 0°C to 50°C
6GHz band	±200kHz/°C from 0°C to 50°C
11GHz band	±1.2MHz/°C from 0°C to 50°C
b. With line voltage	±1MHz max. for AC 103 to 127V variation
c. With output Power	
2, 4 and 6GHz bands	±1MHz max. for 0dBm to +10dBm change
11GHz band	±1MHz max. for 0dBm to +5dBm change
d. With time	±0.012% max. over a 15-minute interval and ±0.03% over any continuous 24 hour period.
(14) Aging	±0.03% for at least 10 years.
(15) Spurious Radiation	Less than −50dBm when output is delivering +10dBm (+5dBm for 11GHz band) into a resistive termination at any frequency. The harmonic radiation up to 11.7GHz is no greater in magnitude than the fundamental radiation. The unit is measured radially for radiation 12-inches from the cabinet using WR-430 waveguide for 2GHz band,WR-229 for 4GHz band, WR-159 for 6GHz band and WR-90 waveguide for 11GHz band.
(16) Harmonics	At least 40dB down.
(17) Spurious Signal (non harmonically related)	At least 64dB below the selected output power when terminated into 50Ω.

Table D (Cont)

(18) Residual Amplitude Modulation	At least 40dB below the output signal.
(19) Residual Frequency Modulation	
2, 4 and 6GHz bands	30kHz peak
11GHz band	50kHz peak
7. IF SWEEP GENERATOR	
(1) CW Mode	70MHz and 74.1MHz
(2) Frequency Setting Accuracy	Within $\pm 2 \times 10^{-5}$
(3) ΔF Sweep Mode	Fixed sweep width ±2, ±10, ±15, ±20MHz
(4) Leveled Power Output	Variable from –70dBm to +10dBm at a 75Ω output impedance.
(5) Continuously Variable	10dB range (+10dBm max.)
(6) Step Variable	70dB range, 1dB steps
(7) Power Output Stability	Within ±0.05dB/15 minute interval and within ±0.1dB/24 hour period.
(8) Power Output Flatness	Within ±0.025dB at ΔF sweep modes between 0 and +10dBm
(9) Sweep Frequency	46Hz nominal
(10) Sweep Linearity	Within ±2.5% of sweep width
(11) IF Frequency Markers	One pair of markers for each of the sweep modes switch selectable in increments of 1MHz between 0 and 20MHz.
(12) IF Frequency Markers Accuracy	±0.005%
(13) IF Generator Frequency Stability (a to d)	
a. With tempeature	±30kHz max./°C at 0°C to 50°C
b. With line voltage	±10kHz max. for AC 103 to 127V variation
c. With output power	±10kHz max. for 0 to +10dBm change
d. With time	±50kHz max. over a 15 minute interval ±100kHz max./24 hour period

Table D (Cont)

(14) Spurious Radiation	The radiation from the fundamental frequency from the IF oscillator is no greater than –100dBm when the output is delivering +10dBm into a resistive termination at any frequency. The harmonic radiation up to 300MHz shall be no greater in magnitude than the fundamental radiation. The unit is measured radially for radiation with a suitable field intensity meter, excited by a simple resonant dipole placed no more than 12 feet and no less than 8 feet from the finished chassis, with no additional shielding.
(15) Harmonics	The magnitude of the second and third harmonic of 50(54.1), 60(64.1), and 70(74.1)MHz present in the generator output is measured by means of a suitable selective analyzer. In addition, the second harmonic of 80(84.1) and 90(94.1)MHz is measured and their magnitudes relative to the fundamental, is no greater than the following:

Fundamental, f, MHz	$\frac{2f}{f}$	$\frac{3f}{f}$
50(54.1)	–40dB	–40dB
60(64.1)	–40dB	–40dB
70(74.1)	–40dB	–40dB
80(84.1)	–40dB	–
90(94.1)	–40dB	–

(16) Spurious Signal (non harmonically related)	At least 70dB below selected output power when terminated in 75Ω
(17) Residual Frequency Modulation	No greater than 1.5kHz peak
(18) Slope Adjusting Range	No less than ±0.1dB slope over 50 to 90 and 54.1 to 94.1 MHz range, front panel adjustment.
(19) Frequency Shift	The 70 and 74.1MHz CW frequencies are shifted by +300kHz and –300kHz for C/I measurements.
8. FREQUENCY COUNTER	
(1) Frequency Range	14 to 300MHz directly and without prescaling.
(2) Input Network	At least 1MΩ shunted by less than 20 pF (14 to 135MHz) and 50Ω (14 to 300MHz) switchable.
(3) Input Level	15mV to 5Vrms without need for level adjustment.
(4) Accuracy	±1 count ± Time Base oscillator stability.

Table D (Cont)

(5) Time Base Stability (a to c)	
a. Short term	a) At least 5×10^{-8} (after 15 minutes warm up) for a minimum of 2 hours and b) At least 5×10^{-9} per day after 24 hours continuous operation.
b. Aging	$\pm 1 \times 10^{-7}$ per year
c. With line voltage	1×10^{-9} for AC 103 to 127V
(6) Time Base Frequency	10MHz
(7) Time Base Output	1V peak-to-peak minimum across 50Ω (TTL compatible)
(8) Time Base Adjustment	A minimum of $\pm 5 \times 10^{-8}$
(9) Oven	Crystal oven remains on when the front panel power switch is turned off.
(10) Sample Rate	Minimum 0.08 seconds. Variable by steps of 0.08, 0.8, 2 seconds and hold.
(11) Gate Time	10, 1 and 0.1 seconds
(12) Resolution	0.1, 1 and 10Hz
RF Measurements (Option 002) (13) to (17)	
(13) RF Frequency Range	2GHz band: 2.11 to 2.18GHz (option 003) 4GHz band: 3.65 to 4.25GHz 6GHz band: 5.8 to 6.5GHz 11GHz band: 10.6 to 11.7GHz (option 001) directly without manual or external prescaling or tuning.
(14) Input Network	Over the specified frequency range the input impedance is a nominal 50Ω.
(15) Input Connector	Type "N" connector.
(16) Input Level	–20dBm to +7dBm
(17) Resolution	1kHz
9. ENVIRONMENTAL	
(1) Specification Compliant Ranges (a to c)	
a. Temperature	0°C to +50°C
b. Altitude	0 to 10000 feet above sea level
c. Relative humidity	10% to 95%

Table D (Cont)

(2) Storage Range	–40°C to +60°C
(3) Warm up Time	a) 15 minutes from turn-on from an ambient of 24°C and b) 60 minutes from turn-on in an ambient of 24°C after being brought in from an environment of –18°C.
(4) Burn-in	96 hour operational burn-in at +50°C
(5) AC Input	Single phase 115 ±12V, 60Hz, $\leq$ 250VA power source.
(6) Shock and Vibration	MIL-STD-810B, Method 514.7 Procedure X, Sinusoidal Cycling only.
a. Shock	At room ambient conditions per MIL-STD-810B 20g, 10 milliseconds, sawtooth ascending pulse, two repetitions in each direction of three mutually perpendicular axis (12 drops).
b. Vibration	0.25 inches displacement, D.A., 5 to 9Hz and 1.0g from 9 to 100Hz. A sweep rate of two minutes per octave ascending and descending in each of three mutually perpendicular axis.
10. MECHANICAL & MISCELLANEOUS	
(1) Weight (including each carrying case)	
Displaying Unit	less than 40 lbs. (<19kg)
Sending Unit	less than 40 lbs. (<19kg)
Ancillary Equipment	less than 40 lbs. (<19kg)
(2) Dimensions (each unit)	16.8in.(426mm)W x 17.8in.(450mm)D x 5.7in.(145mm)H (except for controls, handles, etc.)
(3) AC Power Cord	The 7'6" detachable power cord is yellow and equipped with a NEMA 5-15P ground plug.
(4) Line Fuses	are accessible from the rear panel.
(5) Ground Loop	The MRTS does not exhibit any ground loop problems when in a back-to-back configuration. (RF & IF flatness requirements are met).
(6) N Type Connectors	Internal dimensions and tolerances of mating surfaces meet MIL-C-39012. N connector shells and the nut on male connectors are stainless steel.

Table D (Cont)

(7) Repeater Bay Interfaces	The MRTS interfaces repeater bays with N-type connectors for 50Ω test points, and WECo 560A, or approved equivalent, jacks for 75Ω test points.
(8) Portable Test Rack	A collapsible mobile rack is available to support the MRTS. It does not restrict a view of the MRTS while in a kneeling position making adjustments on a repeater bay near floor level.

SECTION 2

PERFORMANCE TESTS

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1. GENERAL

A. Power Requirement

1.01 This test set operates normally on AC115V ±12V, 50Hz or 60Hz power. Its power consumption is 200VA.

B. Installation Site Environmental Conditions

1.02 This test set satisfies the specifications of item 3 of Section 1 (Table D) at ambient temperature 0°C to 50°C, ambient humidity 10% to 95%. Storage temperature range is –40°C to +60°C.

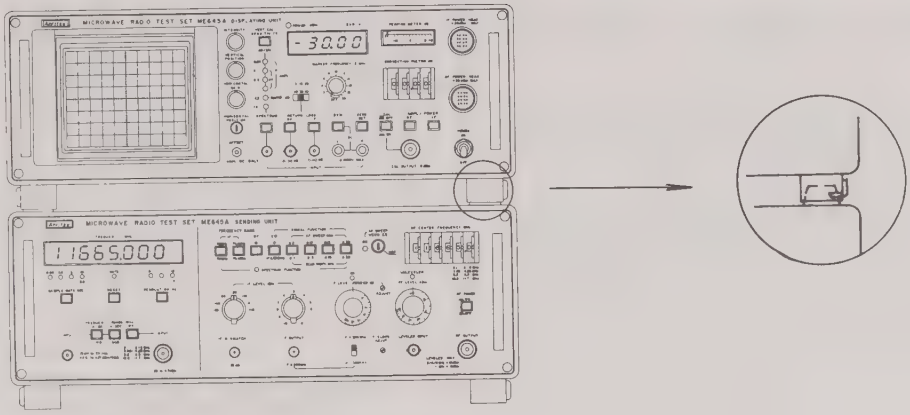


Fig. 1—Installation

C. Assembly, Connection and Installation

Standard Configuration

1.03 Stack the two units as shown in Fig. 1, with the displaying unit on top.

1.04 Secure the units together (4 places) with the furnished lock pins as illustrate in the expanded view of Fig. 1.
This prevents the units from being separated and secures that the cabinets of the two units are at the same electrical potential, thus preventing noise from appearing on the CRT.

1.05 Connect DC OUTPUT (rear panel) of the displaying unit and DC INPUT (rear panel) of the sending unit with the furnished interface cable (FA11).

1.06 Connect the furnished yellow AC power cord to LINE INPUT (rear panel) of the displaying unit.

1.07 Items 1.03–1.06 above complete assembly, connection and installation of the standard configuration.

Optional Configuration

1.08 In addition to the standard configuration, a portable test rack and carrying case are available as options. Assembly, connection, and installation using these options are described below.

1.09 *Portable Test Rack:* Stack the two units in the test rack, and fasten them together and to the portable test rack with the displaying unit on top (4 places + 4 places) as illustrated in Fig. 2.
Other connections are identical to those described in Standard Configuration.
Concerning the angle change and holding of the portable test rack the detailed description is given in item E.

1.10 *Carrying Case:* Two types of carrying case are contained in the Available Ancillary Equipment as shown in Table C of Section 1.
One is a Soft Package Carrying Case for hand carrying use. (A. No. 40)
The other is a Protective Shipping Case for transportion. (A. No. 41)

(a) *Soft Pack Carrying Case:* Pack each unit and the ancillary equipment and carry the cases as illustrated in Fig. 3.

(b) *Protective Shipping Case:* This package is very available for preventing the equipment from the transportation damages. First pack each unit in the Soft Pack Carrying Case and put it in this Shipping Case as illustrated in Fig. 4.

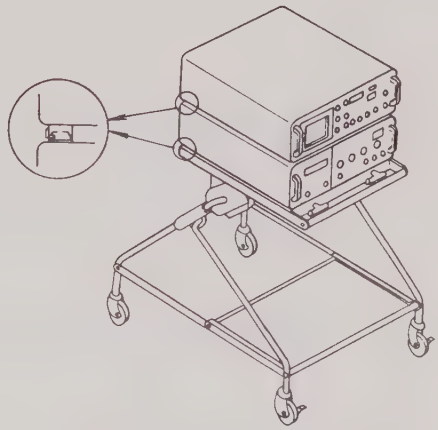
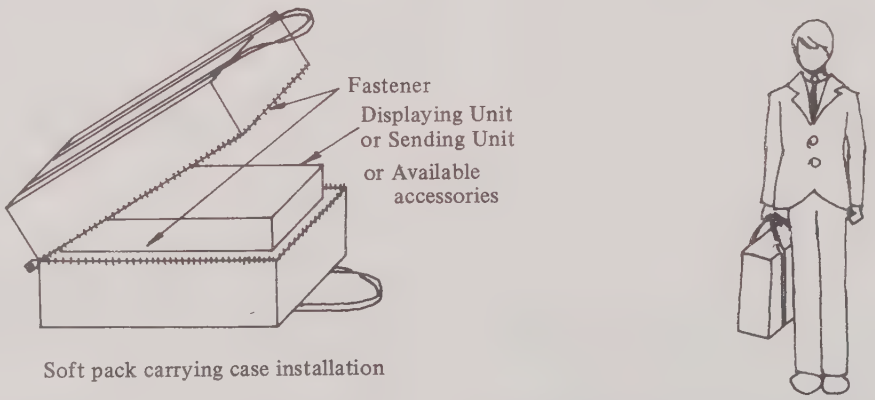
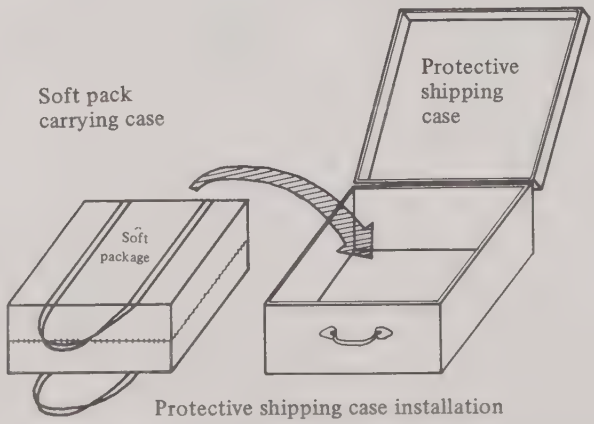


Fig. 2–Portable Test Rack Installation



Soft pack carrying case installation

Fig. 3–Carrying Case



Protective shipping case installation

Fig. 4–Shipping Case

ASAC-104-201-501

D. Usage Notes

1.11 Check the following items before supplying power to the set.

(a) Check that the power line to be connected to the set is AC115V ±12V.

(b) Check that the POWER switch of the displaying unit is set to its OFF position.

(c) Check that the LINE FUSES (rear panel) MAIN (5A) and OVEN (0.5A) of the displaying unit are not blown.

(d) Check that the Test Set is not wet.

E. Changing the Portable Test Rack Table Angle

1.12 The portable test rack table angle can be changed lower 10°, upper 15°, 30° and 45° to the horizontal direction.

1.13 Grip together a cylindrical grip (1) and two levers (2) with your hands and the required angle above.

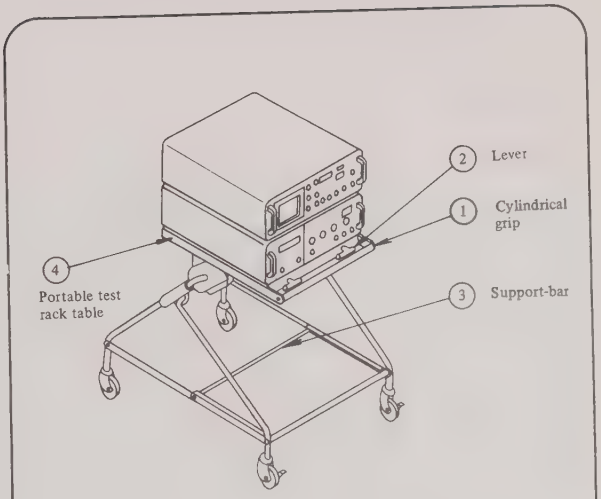


Fig. 5—Changing the Portable Test Rack Table Angle

F. Folding the Portable Test Rack

1.14 Position the portable test rack table angle to 45° upper.

1.15 Lift up the support bar (3).

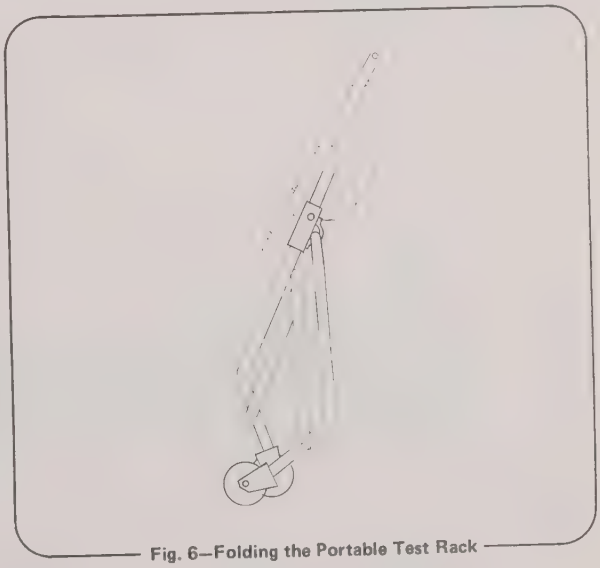
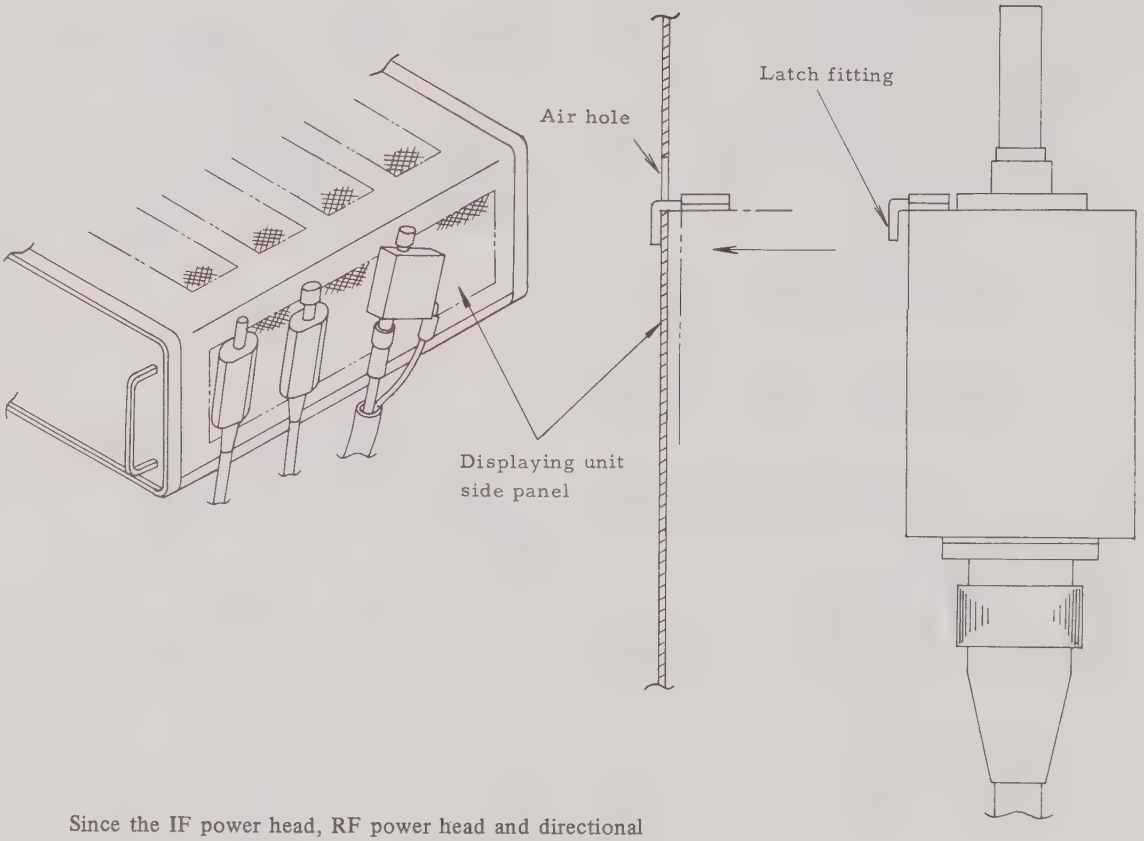


Fig. 6—Folding the Portable Test Rack

G. IF/RF Power Head, Directional Detector Fitting



Since the IF power head, RF power head and directional detector all have latch fittings (1), they can be installed by inserting the latch fitting through the air hole (3) on the display unit side panel (2) as shown above.

Fig. 7—Power Heads, Detector fitting

H. Portable Test Rack Assembly

1.16 Fig. 8: Move the test rack legs apart so that it stands upright on the floor. Swing the levers (1) up and forward so that they are over the front part of the test rack.

1.17 Fig. 9: Level the table (2) and align its mounting holes with the threaded holes in the table support blackets (3). Using the bolts (4), lock washers (5), flat washers (6) and wrench (7) provided, secure the table (2) to its support brackets.

1.18 Fig.10: Lift lever (1) and insert the shaft (A) into slot (B).

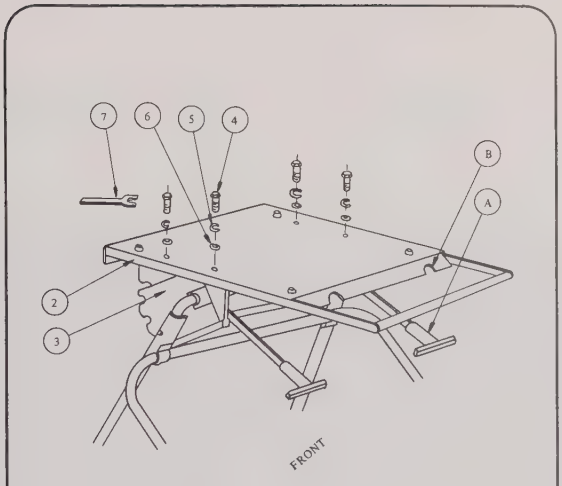


Fig. 9

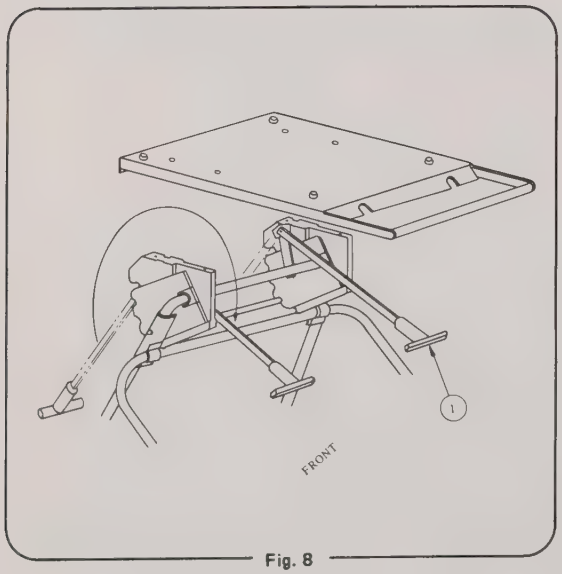


Fig. 8

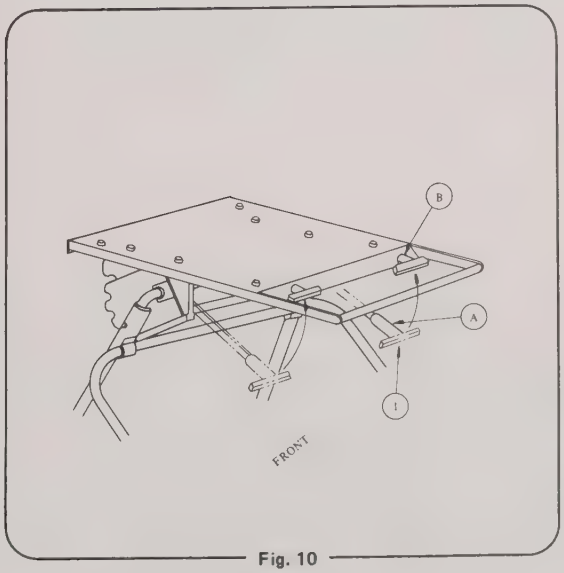


Fig. 10

2. MRTS PANEL DESCRIPTION

A. Displaying Unit

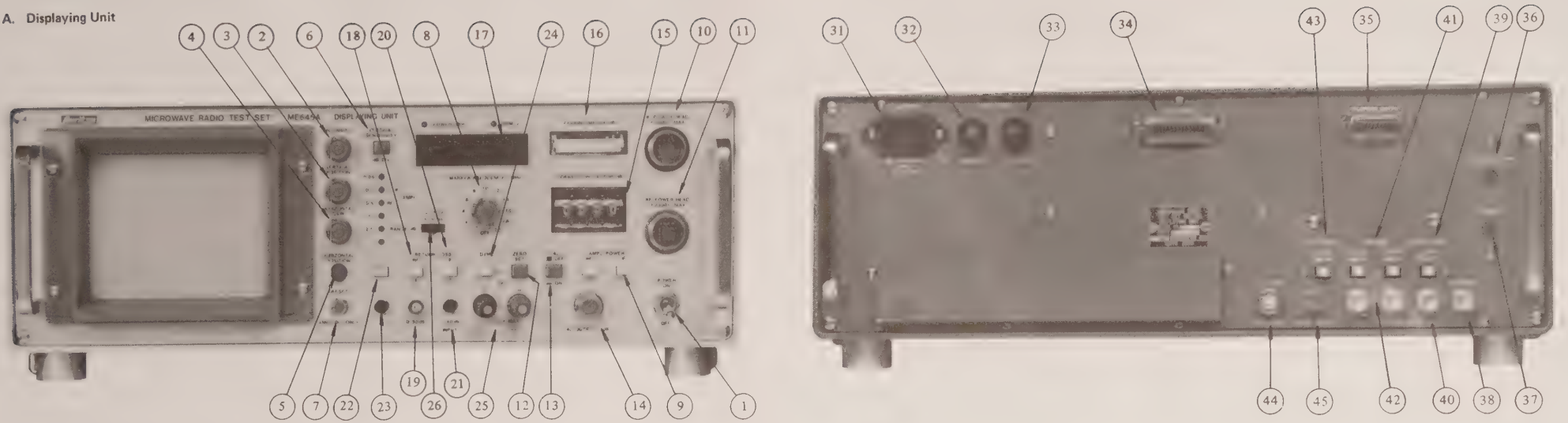


Fig. 11—Displaying Unit Controls

Front Panel

1. POWER: Supplies line voltage to the unit when set to the ON position. The crystal oven remains on even when this power switch is OFF.
2. INTENSITY: Adjusts the display brilliance.
3. VERTICAL POSITION: Varies the vertical position of the CRT trace.
4. HORIZONTAL GAIN: Allows the width of the trace to be varied between 0.5V/DIV and 2V/DIV.
5. HORIZONTAL POSITION: Varies the horizontal position of the CRT trace.
6. VERTICAL SENSITIVITY: Controls the vertical sensitivity during amplitude response measurement. This switch is pushed to cyclically change the sensitivity.
7. OFFSET: Used for only amplitude response measurement (Vertical input: DC). Automatically sets the trace line to center on the CRT.
8. MARKER FREQUENCY: One pair of side markers can be switch selected between 0 and 20MHz in increments of 1MHz, and the center marker is superimposed on the CRT measuring trace.
9. AMPL/POWER (IF, RF): Selects the power and amplitude response measurement.
10. IF POWER HEAD: Connects the IF power head for IF power or IF amplitude response measurements. Black is marked to avoid the misconnection of the power head. Black is also marked on the cable and power head in the same way.
11. RF POWER HEAD: Connects the RF power head for RF power of RF amplitude response measurements. Green is marked to avoid the misconnection of the power head.
12. ZERO SET: Automatically sets the POWER METER to zero. During this operation, power should not be supplied to the power head.
13. CAL: Calibrates the sensitivity of the POWER METER.
14. CAL OUTPUT 0dBm: Provides an accurate 0dBm standard signal for power meter calibration.
15. CORRECTION FACTOR dB: Used for reading the absolute input power when component loss is set on this thumb switch.
16. PEAKING METER dB: Indicates the input power.
17. POWER dBm. DVM V: Displays the power or DC voltage value, depending on the setting of the POWER (9) or DVM (24).
18. RETURN LOSS RF: Selects RF return loss measurement.
19. INPUT: Accepts the return loss measurement signal via RF return loss bridge.
20. RETURN LOSS IF: Selects IF return loss measurement.
21. INPUT: Accepts the return loss measurement signal via IF return loss bridge.
22. SPECTRUM: Selects C/I or XPD measurements.
23. INPUT: Accepts the IF signal via repeater for C/I or XPD measurements.
24. DVM: Selects DC voltage measurements. When the DVM switch is pushed, the entire CRT screen brightens. (The CRT scale can be photographed without a flash attachment).
25. INPUT: Accepts DC voltage.
26. RANGE dB: Selects the measuring ranges (IF: 3 ranges, RF: 2 ranges) for return loss measurements.

Rear Panel

31 LINE INPUT: Accepts line voltage.

32 LINE FUSE MAIN: For all circuits except the oven.

33 LINE FUSE OVEN: For the oven in the frequency counter section.

34 DC OUTPUT: Supplies the DC power source for the SENDING UNIT.

35 RECORDER OUTPUT: Supplies the X, Y axis and pen lift signals for recording C/I and XPD measurements.

36 TRACE ROTATION: Aligns the trace with the horizontal graticule lines.

37 FOCUS: Controls display definition.

38 BLANKING: Accepts the blanking to the CRT trace.

39 HORIZONTAL:

- INT: Selects the internal sweep rate. (46Hz)
- EXT: Sets the external sweep signal source for the horizontal deflection.

40 EXTERNAL SIGNAL INPUT: Supplies the external X-axis input to the CRT.

41 VERTICAL:

- INT: Enables display of the amplitude response, return loss, etc. measuring trace.
- EXT: Displays the input signal trace from INPUT (42).
- AC: Input signal from INPUT (42) and internal signal are coupled to AC.
- DC: Input signal from INPUT (42) and internal signal are coupled to DC.

42 EXTERNAL SIGNAL INPUT: Accepts the balanced Y-axis signal when the VERTICAL (41) is in the EXT position. This input has a sensitivity of 50mV/cm.

43 CAL OUTPUT: When the CAL (13) switch on the front panel is "OFF" and this switch is "ON" the CAL OUTPUT level can be adjusted to 0dBm by the level adjuster located in the lower part of the displaying unit.

44 DC OUTPUT (TO IF AMP): Supplies the DC power source to the IF AMP (A. No. 34).

45 LOCAL INPUT: Accepts the local signal from Sending Unit LOCAL OUTPUT (91) for spectrum functions.

B. Sending Unit

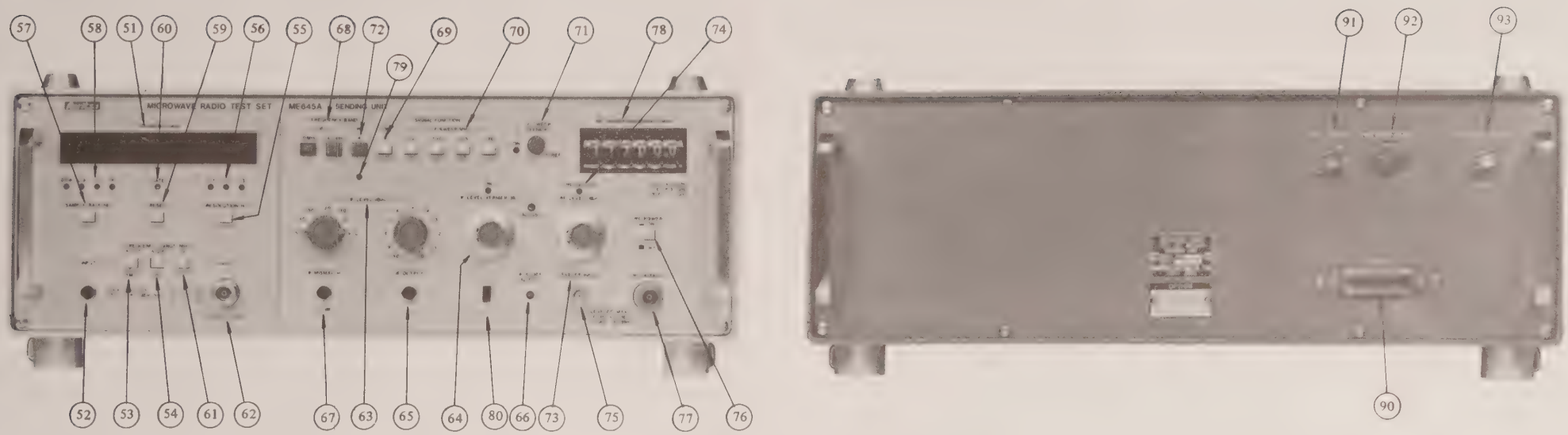


Fig. 12—Sending Unit Controls

Front Panel

51 FREQUENCY MHz: Displays the frequency of input signals applied to INPUT (52) or (62).

52 INPUT: Accepts signals for frequency measurement from 14MHz to 300MHz.

53 54 FREQUENCY RANGE: Selects the frequency range according to the INPUT (52) signal to be measured.

55 RESOLUTION Hz: Controls the resolution when measuring frequency.

56 0.1 1 10 lamp: Indicates that the resolution frequency is selected on the "RESOLUTION" (55) switch. When the "RESOLUTION" switch is pushed the resolution changes cyclically from 0.1Hz, 1Hz, 10Hz and then to 0.1Hz again.

57 SAMPLE RATE: Controls the time from the end of one count, to the beginning of the next count.

58 0.08 0.8 2 ∞ lamp: Indicate that the sample rate is selected on the "SAMPLE RATE" (57) switch. After power is turned ON, the sample rate is automatically set to 80ms. Each time the "SAMPLE RATE" (57) switch is pushed the sample rate changes cyclically from 80ms, 0.8sec, 2sec, ∞ (hold) and then to 80ms again.

59 RESET: Immediately clears the frequency display on the FREQUENCY (51) indicator.

60 GATE lamp: Lights while measuring frequency.

RF FREQUENCY MEASUREMENT (OPTION 002)
(Green Function)

61 RF: Selects RF frequency measurement.

62 INPUT: Accepts RF signal of the frequency range displayed on the panel.

56 1k lamp: The resolution is fixed at 1kHz.

58 0.8 lamp: The sample rate is fixed at 0.8sec.

63 IF LEVEL dBm: Varies the IF output level from +10 to −60dBm in 1dB resolution.

64 IF LEVEL VERNIER dB: Controls the IF output level. When it is set in the extreme clockwise position (indicator lamps does not light) output level is determined by the indication of IF LEVEL attenuator (63).

65 IF OUTPUT: Provides IF signal.

66 IF SLOPE ADJUST: Varies the slope of swept output.

67 IF MISMATCH: Provides the reference mismatch loss 20dB for the calibration of return loss measurement.

68 IF: Selects output signal of 70 or 74.1MHz.

69 CW: Sets unswept IF and RF output signals.

70 ΔF SWEEP MHz: Selects the sweep width of IF and RF signals. For spectrum function, select the scan width of the local oscillator.

71 ΔF SWEEP VERNIER: Controls the ΔF SWEEP width. When it is set in the extreme clockwise position (indicator lamp does not light), ΔF SWEEP width is determined by the ΔF SWEEP (70) switch.

72 RF: Selects output signal. An RF signal only is supplied from RF OUTPUT (77).

73 RF LEVEL ADJUST dBm: Controls the RF output level.

74 UNLEVELED: Lights when the RF LEVEL ADJUST is set too high for leveling across the selected frequency and RF power off.

75 LEVELER INPUT: Accepts the external control signal input. Usually apply the signal from the FA3 Directional Detector.

76 RF POWER: Controls RF output. When it is in the ON position, RF output appears at RF OUTPUT (77).

77 RF OUTPUT: Supplies RF signal.

78 RF CENTER FREQUENCY MHz: Varies the RF signal center frequency.

79 SPECTRUM FUNCTION: Indicates that the SPECTRUM switch (22) on the displaying unit is pushed. In this condition all function displays (markings) in black letter on the Sending Unit are changed to the functions indicated in blue.

80 IF +300kHz, IF −300kHz: Selects the 300kHz shifted IF signal for C/I measurements.

Rear Panel

⑨⓪ DC INPUT: Accepts DC power and control signal input to operate SENDING UNIT by directly connecting DC OUTPUT (TO SENDING UNIT) (34) of the DISPLAYING UNIT.

⑨① LOCAL OUTPUT: Provides local signal for spectrum functions, connected to LOCAL INPUT (45) of Displaying Unit.

⑨② TIME BASE ADJ: Adjusts the time base frequency to 10MHz.

⑨③ TIME BASE OUTPUT: Supplies 10MHz time base signal for calibrating the frequency counter.

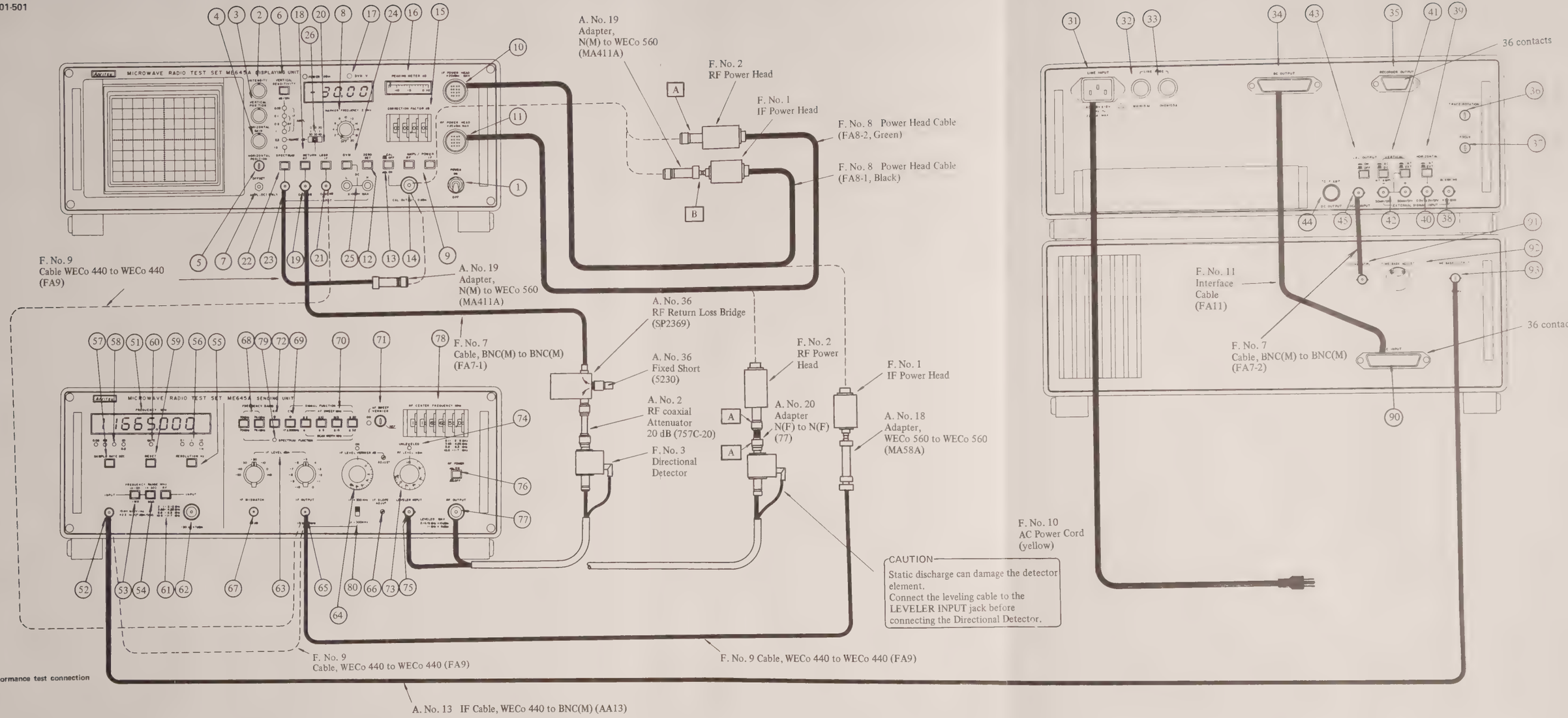


Fig. 13—Performance test connection

3. BACK-TO-BACK CHECKS

A. Introduction

3.01 Before proceeding to Section 3 Measurements, check the back-to-back performance of the MRTS. This section is concerned with verifying that the MRTS is operating normally when it is first unpacked, after being moved a long distance, or after being out of service for a long time. Because this performance check must be conducted even at the repeater site, special instruments are not required for the check in this paragraph. Refer to the separate Service Manual, for calibration details.

B. Connections

3.02 Connect as specified for the following items, seeing Fig. 13.

C. CRT Display Check

3.03 Set the controls as follows:

STEP	PROCEDURE
1	POWER switch (1) ..... ON
2	HORIZONTAL (39) ..... INT
3	VERTICAL (41) ..... EXT, DC
4	Adjust the brightness with INTENSITY (2).
5	Adjust VERTICAL POSITION (3) so that the horizontal base line is exactly on the center graticule line on the CRT screen.
6	Adjust HORIZONTAL GAIN (4) until the displayed scan width is exactly 10 divisions.

3.04 When the above setting and adjustments are completed, the CRT circuit is normal.

D. RF Power Meter Check

STEP	PROCEDURE
1	Connect RF Power Head to CAL OUTPUT 0dBm (14).
2	Push AMPL/POWER RF (9) (POWER dBm (17) lamp on the digital display lights).
3	Set the correction factor indicated on the RF Power Head to CORRECTION FACTOR (15).
4	Set the CAL OUTPUT (43) (rear panel) to OFF position.
5	Push ZERO SET (12) 0 flahses on and off until zero setting of the digital display (17) is performed. Then, – (minus sign) flashes on and off. The above completes the power meter Zero Setting.
6	Push CAL (13) ON +88.88 is displayed on the digital display (17) for approximately 3.5 seconds. This means that all segments of the indicator are normal. After that 0.00 is displayed, the RF Power Head is calibrated exactly with the internal reference oscillator, and the RF power meter is normal.
7	Push CAL (13) again (Release CAL) OFF.

E. IF Power Meter Check

STEP	PROCEDURE
1	Connect IF Power Head to CAL OUTPUT 0 dBm (14) with Adapter MA411A.
2	Push AMPL/POWER IF (9).
3	Add the correction factor indicated on the IF Power Head and the correction factor possibly 0.18dB indicated on the Adapter N(M) to WECo 560 (MA411A).
4	Set added correction factor to CORRECTION FACTOR (15) .
5	Push ZERO SET (12).
6	Push CAL (13) ON.
7	Push CAL again (Release CAL) to OFF.
	Note: Refer to steps 5 to 7 of item D concerning steps 5 to 7 above.

F. Frequency Counter Check

STEP	PROCEDURE
1	Push FREQUENCY RANGE 14-300 (54).
2	Push RESOLUTION Hz (55), and light to 1Hz (56) .
3	Push RESET (59) for approximately two seconds. 0 becomes 8 in all digits. This means the all segments of the indicate are normal.
4	Release RESET (59) . The counter displays 10.000000MHz. Both 9.999999 and 10.000001MHz are normal displays. This is due to the accountable ±1 count error of the digital counter.

G. IF Amplitude Response and IF Power Output Check

STEP	PROCEDURE
1	After IF power meter check in item E, connect cable (F. No. 9 Cable, WECo 440 to WECo 440 (FA9)) to IF OUTPUT (65) of the Sending Unit as shown in Fig. 13.
2	Connect cable (FA9) and IF Power Head with the Adapter MA58A (WECo 560 to WECo 560, A. No. 18) as shown in Fig. 13.
3	VERTICAL (41) ..... INT, AC
4	HORIZONTAL (39) ..... INT
5	Push AMPL/POWER IF (9).
6	Push VERTICAL SENSITIVITY (6), and light to 0.05.
7	Push IF 70 or 74.1MHz (68).
8	Push ΔF SWEEP MHz (70) ±20MHz.
9	Set IF LEVEL dBm (63) to 0dBm.
10	Turn IF LEVEL VERNIER (64) fully clockwise. (Vernier indicator goes off.)
11	Set MARKER FREQUENCY MHz (8) to 20MHz. Three maker pulses appear at both ends and the center of the amplitude response image. This means the IF signal is swept normally.
12	Adjust VERTICAL POSITION (3) to set the image on the CRT to the center graduation. *Note:* According to the above procedures, an amplitude response measurement of less than ±0.025dB should be observed on the CRT. If the amplitude response is over ±0.025dB, it should be adjusted to the minimum deviation by the IF SLOPE ADJUST (66), observing the amplitude response image on the CRT.
13	Push CW (69). IF Power between –0.5dBm and +0.5dBm is displayed on the digital display (17).
14	Set IF LEVEL dBm (63) to other positions from +10 to –30dBm. Confirm the IF power output accuracy of ±0.5dB on the digital display (17).

H. IF Return Loss Circuit Check

STEP	PROCEDURE
1	After checking in accordance with item G, disconnect the IF POWER HEAD from IF OUTPUT (65).
2	Connect cable FA9 (WECo 440 to WECo 440) between IF OUTPUT (65) and RETURN LOSS IF INPUT (21), as shown by the dotted lines in Fig. 13.
3	Push RETURN LOSS IF (20). The VERTICAL SENSITIVITY 2.5dB lamp should light.
4	Set RANGE dB (26) to 10 –30.
5	Push ΔF SWEEP MHz (70) ±20MHz.
6	Set IF LEVEL dBm (63) to –36dBm, and turn IF LEVEL VERNIER dB (64) fully clockwise.
7	Adjust VERTICAL POSITION (3) to set the CRT trace on the center graticule.
8	Change IF LEVEL dBm (63) to –46dBm. The CRT trace should shift to the bottom graticule. In the same manner, change IF LEVEL dBm (63) to –26dBm. The CRT trace should shift to the top graticule. This means that the IF return loss circuit is operating normally.
9	Reset IF LEVEL dBm (63) to –36dBm.
10	Change RANGE dB (26) to 0 –20. The CRT trace should shift to the bottom graticule. In the same manner, change RANGE dB (26) to 20 – 40. The CRT trace should shift to the top graticule. The means that the IF return loss range circuit is operating normally.

I. IF Frequency Check

STEP	PROCEDURE
1	Connect the IF OUTPUT (65) and INPUT (52) on the frequency counter with a cable (Cable, FA9 WECo 440 to WECo 440) as shown by the dotted lines in Fig. 13.
2	Push CW (69).
3	Push FREQUENCY RANGE MHz 14-300 (54).
4	Push RESOLUTION Hz (55) and light to 10 (56).
	For the 70MHz IF Frequency, the display is within 69.99859 MHz and 70.00141MHz. For 74.1MHz: 74.09850MHz and 74.10149MHz.

J. RF Power Output Level Check

STEP	PROCEDURE
1	After RF power meter check in item D, connect [A] to [A] using the Adapter 77 (N(F) to N(F) A. No. 20) as shown in Fig. 13.
2	Push RF (72).
3	Set RF CENTER FREQUENCY MHz (78) to the required frequency of 2, 4, 6 or 11GHz (ex. set to 6425.5MHz).
4	Push CW (69).
5	Push FREQUENCY RANGE MHz 14-135 (53) or 14-300 (54). (If FREQUENCY RANGE MHz RF (61) is pushed, RF CW Power cannot be provided from RF OUTPUT (77).)
6	Push RF POWER (76) ..... ON
7	Push AMPL/POWER RF (9).
8	Set the RF Power Head correction factor at the required frequency to CORRECTION FACTOR (15).
9	Adjust RF LEVEL ADJUST (73) so that the power display (17) indicates +10dBm (2, 4, 6GHz bands) or +5dBm (11GHz band). Then, check that the UNLEVELED lamp (74) does not light at this level. At the same time, check that power output can be set down to −10dBm with RF LEVEL ADJUST (73).

K. RF Amplitude Response Check

STEP	PROCEDURE
1	After RF power output level check in item J, push ΔF SWEEP MHz (70) ±10MHz (2GHz, 4GHz bands) or ±20MHz (6 and 11GHz bands).
2	Adjust RF LEVEL ADJUST (73) to +10dBm (2, 4, 6GHz bands) or +5dBm (11GHz band).
3	Push HORIZONTAL (39) ..... INT
4	VERTICAL (41) ..... INT, AC
5	Push VERTICAL SENSITIVITY (6). The indicator lights the sensitivity to 0.1dB/DIV.
6	Adjust VERTICAL POSITION (3) to set the image on the CRT to the center graticule. If the following amplitude responses are observed, the RF amplitude response check has been performed properly. Less than ±0.025dB/±10MHz (2.11 to 2.18GHz) ..... option 003 Less than ±0.025dB/±10MHz (3.65 to 4.25GHz) Less than ±0.025dB/±20MHz (5.8 to 6.5GHz) Less than ±0.05dB/±20MHz (10.6 to 11.7GHz) ..... option 001

L. RF Return Loss Circuit Check

STEP	PROCEDURE
1	After checking in accordance with item J, set RF LEVEL ADJUST dBm (73) to +2dBm.
2	Disconnect the RF POWER HEAD from the Directional Detector, and connect RF Coaxial Attenuator 20dB 757C-20 (A. No. 2), and RF Return Loss Bridge SP2369 (A. No. 36). Connect the Fixed Short 5230 (A. No. 36) to the RF Return Loss Bridge test port. Connect the detected VSWR output of RF Return Loss Bridge to the RETURN LOSS RF (19), as shown in Fig. 13.
3	Push RETURN LOSS RF (18). The VERTICAL SENSITIVITY 2.5dB lamp should light.
4	Set RANGE dB (26) to 10 – 30.
5	Adjust VERTICAL POSITION (3) to set the CRT trace to the center graticule.
6	Change RF Coaxial Attenuator 20dB 757C-20 (A. No. 2) to 30dB 757C-30 (A. No. 3). The CRT trace should shift to the bottom graticule. In the same manner, change to RF Coaxial Attenuator 10dB 757C-10 (A. No. 1). The CRT trace should shift to the top graticule. This means that the RF return loss circuit is operating normally.
7	Replace RF Coaxial Attenuator 10dB 757C-10 (A. No. 1) to 20dB 757C-20 (A. No. 2).
8	Change RANGE dB (26) to 0 – 20. The CRT trace should shift to the bottom graticule. This means that the RF return loss range circuit is operating normally.

M. Coarse RF Frequency Check

STEP	PROCEDURE
1	Connection and control settings are almost the same as items J and K.
2	Connect the 4GHz coaxial low pass filter MA62A (F. No. 4) between the Adapter 77 and the RF Power Head.
3	Set RF CENTER FREQUENCY MHz (78) to 5800.0MHz.
4	Turn RF LEVEL ADJUST dBm (73) fully clockwise.
5	Push ΔF SWEEP MHz (70) ±10MHz.
6	Push VERTICAL SENSITIVITY (6). The indicator lights the sensitivity to 0.1 dB/DIV.
7	Adjust VERTICAL POSITION (3) to display the trace on the CRT. Refer to Fig. 14.

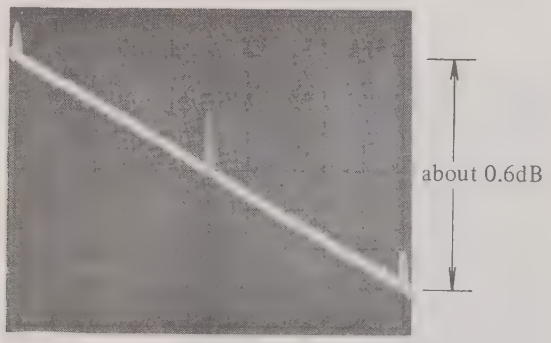


Fig. 14 Measured Result of Coarse RF Frequency

The RF frequency is coarse-checked in this manner using the amplitude slope of LPF. A frequency meter or counter is required for accurate frequency measurement.

N. Spectrum Function Check

STEP	PROCEDURE
1	Connect LOCAL OUTPUT (91) to LOCAL INPUT (45) by cable FA7-2 as shown in Fig. 13.
2	Connect CAL OUTPUT (14) to SPECTRUM INPUT (23) by cable FA9 and coaxial adapter MA411A as shown in Fig. 13.
3	Push SPECTRUM (22). Vertical sensitivity indicates 10dB/DIV.
4	Push SCAN WIDTH MHz (70) ..... ±32MHz
5	Push IF 70 MHz (68).
6	Push CAL (13) ON.
7	Adjust VERTICAL POSITION (3) to display the image on the CRT. Refer to Fig. 15.

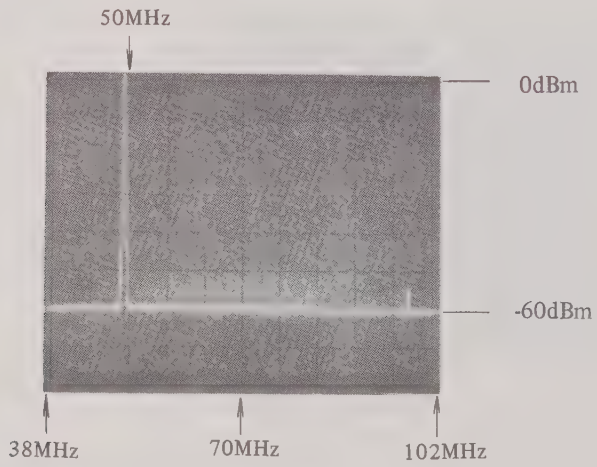


Fig. 15 Measured Result of Spectrum Operation

SECTION 3

MEASUREMENT

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1. POWER MEASUREMENT (IF AND RF)

1.01 An IF Power Head and RF Power Head are provided for IF and RF Power Measurement in this Test Set. IF or RF Measurement can be selected by pushing the appropriate switch.
In the range from +10 to –30dBm, absolute power is measured on the digital indicator.

1.02 *Calibration:* Zero-set and calibrate according to item D and E of Section 2.

1.03 After turning power on, zero-set and calibrate the power meter at least once before taking measurements. If this is not done, a displayed value which might include an error flashes on and off on the digital indicator.

1.04 For measurement modes other than power, the zero setting and calibrating functions do not operate even when the ZERO SET or CAL switch is pushed.

1.05 If the Power Head is connected to some power source which has an output level of outside 0dBm ±3dB, and CAL switch (13) is pushed, +88 88 flashes on and off on the digital indicator, indicating that the power input level is not suitable for the Power Head calibration.

1.06 The calibration function operates at the any level from –3 to +3dBm.
If, therefore, the Power Head input level for calibration is not 0dBm but +0.5dBm, for instance, measured results after such calibration have a 0.5dB error.

1.07 *Measuring Procedure:*

STEP	PROCEDURE
1	Select AMPL/POWER IF or RF (9) according to the measurement item.
2	Perform zero-setting and calibration if necessary. (see item D or E of Section 2.)
3	Calibrate if necessary. (see item D or E of Section 2.)
4	Set CORRECTION FACTOR (15) to the value indicated on the calibration curve for the Power Head.
5	Connect the Power Head to the device under test.
6	Read the value on POWER dBm digital display (17).
	Note: If + (plus sign) or – (minus sign) flashes on and off, it means that the input level is too high or too low.

1.08 *Correction Factor:* If some lossy components such as attenuators or cables are inserted between the Power Head and device under test, add the losses to the CORRECTION FACTOR (15).
Then, the power at the measuring terminal appears on the digital display.

Example 1: RF Power Measurement (see Fig. 1)

(1) Read loss of Pad 768-20-SP at 4000MHz
. . . . . ex. 20.25dB
(2) Read loss of Pad 757C-10 at 4000MHz
. . . . . ex. 10.05dB
(3) Read loss of Low Pass Filter MA62A at 4000MHz
. . . . . ex. 0.15dB
(4) Read the RF Power Head correction factor at 4000MHz . . . . . ex. 0.20dB
(5) Add losses in Steps 1, 2, 3 and 4 . . . . . 30.65dB
Set CORRECTION FACTOR (15) to 30.65dB
(6) Read POWER dBm (17) . . . . . ex. 39.00dBm
39.00dBm indicates Transmitter output power.

Example 2: IF Power Measurement (see Fig. 2)

Fig. 2 shows an example in which power and frequency are simultaneously measured using the splitting pad. Add the losses or correction factors of the IF Cable, Splitting Pad, and IF Power Head and set CORRECTION FACTOR (15) to them. The maximum input power is +24dBm.

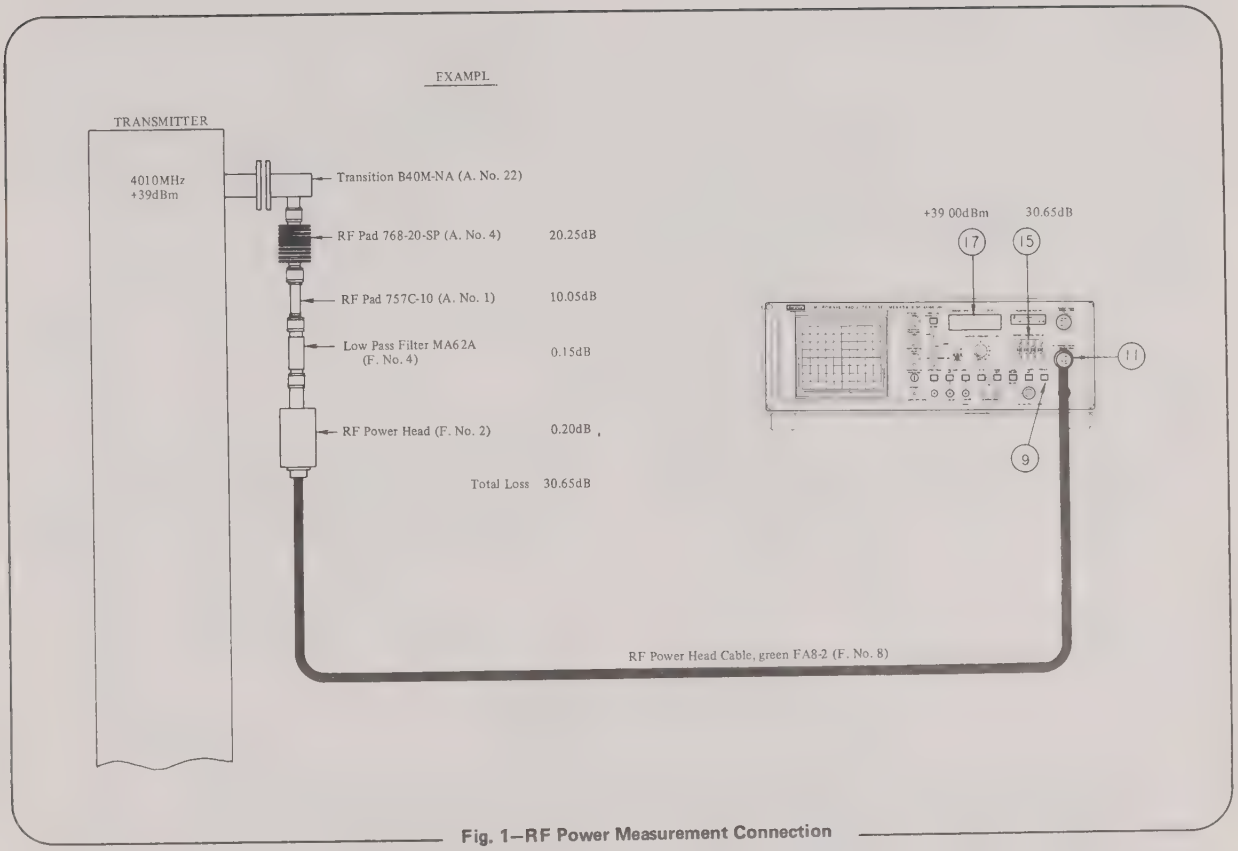


Fig. 1—RF Power Measurement Connection

1.09 Digital Display Operations are shown in Table A.

Table A—Digital Display Operations

	Power Measurement	DC Voltage Measurement
Zero Setting Calibration	The least significant digit 0 flashes on and off. (a) Segment Check +88.88 (approx. 3.5 seconds) (b) CAL finished 0.00 If the input level is abnormal. +88.88 flashes on and off. (See item 1.05)	
Sign and Digits	Plus or minus sign 4 digits ex. −21.35 + 3.76 Read zero suppress. If ZERO and CAL settings have not been performed, all digits flash on and off.	Plus or minus sign 3 digits ex. +115.7 −385
Over Range	More than +11.99dBm at Power Head input terminal.	More than +999 Volts
	+ (plus sign) flashes on and off and the numerical display does not appear.	
Under Range	Less than −39.99dBm at Power Head input terminal.	Less than −999 Volts
	− (minus sign) flashes on and off and the numerical display does not appear.	

2. FREQUENCY MEASUREMENT

2.01 The frequency counter of the MRTS can measure frequencies from the basic frequency to the shift frequency (14.82593 to 252.04MHz) of a repeater common carrier supply. The input level range at the counter input connector is +27 to −23dBm (5Vrms to 15mVrms). There are two input impedances; 50Ω (14 to 300MHz) and 1MΩ (14 to 135MHz).

A. Measurement of 14 to 300MHz Frequency (50Ω)

(a) Push FREQUENCY RANGE MHz 14–300 50Ω (54).

(b) The resolutioin frequency is selected by the RESOLUTION (55) switch. The first setting is 10Hz. Every time this switch is pushed, the resolution changes cyclically.
10Hz → 1Hz → 0.1Hz → 10Hz

(c) The sample rate is selected by the SAMPLE RATE (57) switch. The first setting is 0.08 seconds. Every time this switch is pushed, the sample rate changes cyclically.
0.08sec → 0.8sec → 2sec → ∞ → 0.08sec

(d) Connect the equipment as shown in Fig. 2 according to the repeater test terminal or level, and apply a measuring signal to the INPUT connector. The measurable frequency range is 14 to 300MHz, and the input voltage range is from 15mVrms to 5Vrms. (–23 to +27dBm)

(e) Under this condition, the displayed count represents the measuring signal frequency. A position decimal point is also displayed. If nothing is indicated, or the indication fluctuates, check the input signal level to the counter.

2.02 When the POWER (1) switch and FREQUENCY RANGE (53) (54) switch, are returned to their ON positions or a temporary extreme level fluctuation is noted in the input signal, the display may become blank for a few seconds until the circuits stabilize, even though a signal is present. However, this does not indicate a malfunction.

2.03 A measurement example related to the position of the RESOLUTION Hz indicators is given below.

	Input signal	14.82593MHz
Resolution 10Hz		14.82593
Resolution 1Hz		14.825930
Resolution 0.1Hz		14.8259300

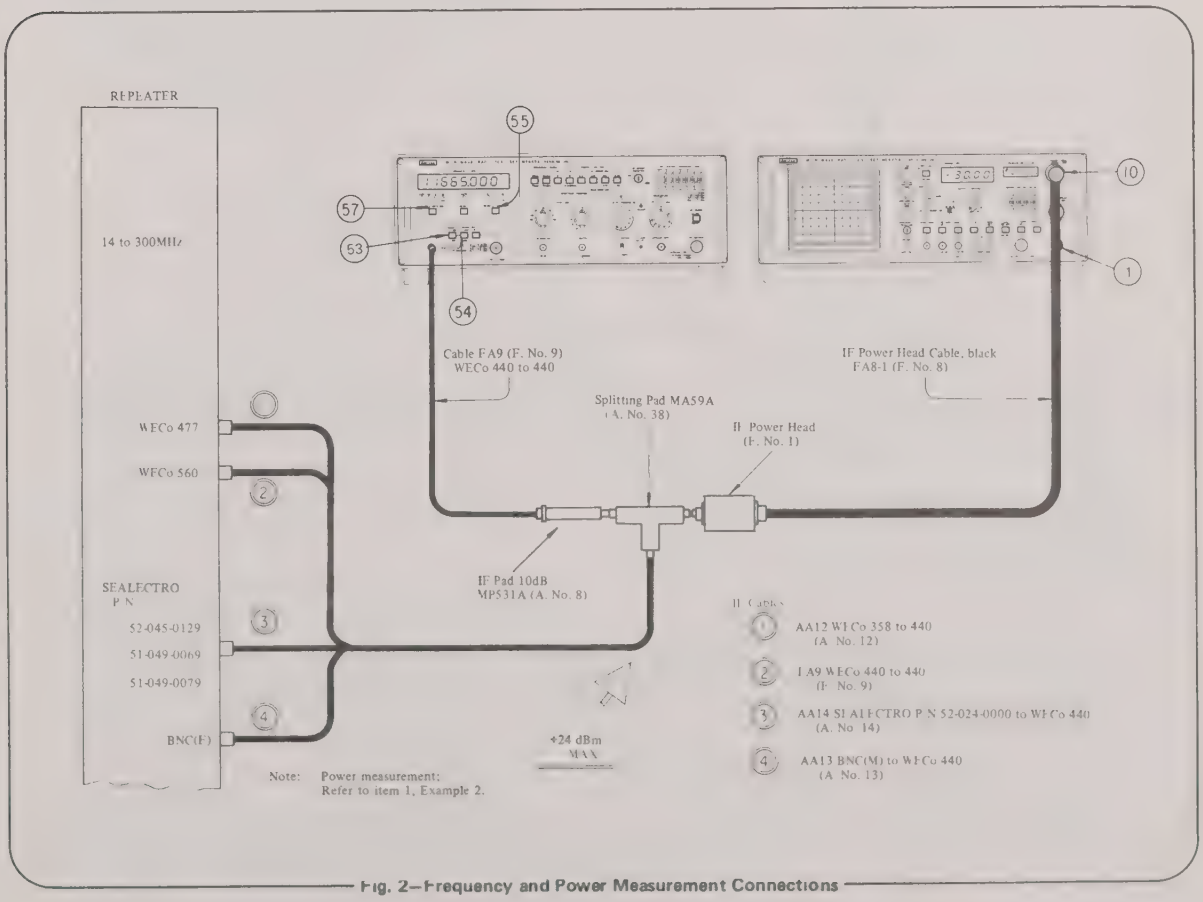

REPEATER
14 to 300MHz
WECo 477
WECo 560
SEALECTRO P/N
52-045-0129
51-049-0069
51-049-0079
BNC(F)
55
57
53
54
10
1
Cable FA9 (F. No. 9) WECo 440 to 440
IF Power Head Cable, black FA8-1 (F. No. 8)
Splitting Pad MA59A (A. No. 38)
IF Power Head (F. No. 1)
IF Pad 10dB MP531A (A. No. 8)
+24 dBm MAX
Note: Power measurement: Refer to item 1, Example 2.
AA12 WECo 358 to 440 (A. No. 12)
FA9 WECo 440 to 440 (F. No. 9)
AA14 SEALECTRO P/N 52-024-0000 to WECo 440 (A. No. 14)
AA13 BNC(M) to WECo 440 (A. No. 13)

Fig. 2–Frequency and Power Measurement Connections

B. Measurement of 14 to 135MHz Frequency (1MΩ)

(a) Push FREQUENCY RANGE MHz 14-135, 1MΩ (53).

(b) Connect the equipment according to the level and impedance of the repeater test terminal or device under test and apply a measuring signal to the INPUT connector.
The measurable frequency range is 14 to 135MHz, and the input voltage is from 15mVrms to 5Vrms.

(c) Under this condition, the displayed counter represents the measuring signal frequency. A positioned decimal point is also displayed.

Caution: If nothing is indicated, or the indication fluctuates, see item 2.02.

C. Measurement of RF Frequency (Option 002)

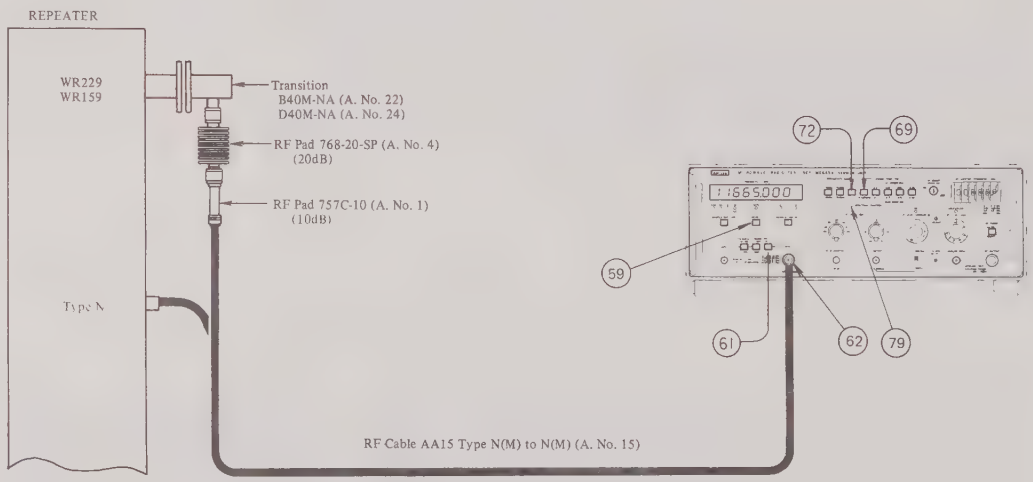


Fig. 3—RF Frequency Measurement Connections

(a) Connections are shown in Fig. 3.
The measurement ranges are 3.65 to 4.25GHz, and 5.8 to 6.5GHz. When option 001 is added, the 10.6 to 11.7GHz range can be measured in addition to the above 4 and 6GHz bands.
When option 003 is added, the 2.11 to 2.18GHz range can also be measured.

(b) Push the RETURN LOSS (18), (20), DVM (24) or AMPL/POWER (9) switch on the displaying unit. In this condition, the SPECTRUM FUNCTION lamp (79) on the sending unit is off.

(c) Push the FREQUENCY BAND RF (72) and SIGNAL FUNCTION CW (69) switches.

(d) Push FREQUENCY RANGE RF (61).

(e) According to the above procedures the sample rate is fixed to 0.8 second and the resolution rate to 1kHz.

(f) Connect the measured signal to INPUT (62). Input level ranges from −20 to +7dBm.

DO NOT EXCEED +20dBm

2.04 When the input signal is less than −20dBm, 0.000 is displayed.

2.05 When the out of band signal is applied to the RF INPUT (62), 0 is flashes on and off.

2.06 When the input signal contains a lower frequency spurious signal over –30dBm level, an error count occurs. Measure by inserting high pass filters or RF pads.

2.07 When the input signal hit is less than 10msec, the input signal harmonic frequency is rarely displayed except for the 11GHz band. Push the RESET (59) switch.

2.08 Maximum local leakage from the RF INPUT (62) is less than –20dBm. If necessary, connect pads or isolators to the INPUT connector.

3. AMPLITUDE RESPONSE MEASUREMENT

A. Introduction

3.01 There are four kinds of amplitude measurements in microwave relay systems. They are as follows.

IF to IF: IF Components (IF Amplifier, IF Filter etc.)
IF to RF: Up Converter (Transmitter Section)
RF to IF: Down converter (Receiver Section)
RF to RF: Over all Repeater (Receiver to Transmitter) and RF Components (RF Amplifier, RF Filter etc.)

3.02 *IF Sending Side:* Three sections of the Sending Side shown in Fig. 4, are contained in the MRTS Sending Unit.

(a) Center frequency (f_o):
70 or 74.1MHz is selected by IF push buttons (68) on the front panel.

(b) Sweep width (ΔF)
There are two types of sweep width settings: fixed and continuously variable.
The ΔF SWEEP MHz (70) switch on the front panel sets the sweep frequency to ±2, ±10, ±15 or ±20MHz. Set the ΔF SWEEP VERNIER (71) switch to REF. (fully clockwise)
The range ±4 to ±20MHz is available with the continuously variable sweep width setting by using the SWEEP MHz (70) and SWEEP VERNIER (71) switches.
The relationship between the SWEEP MHz (70) switch and sweep widths is shown in Table B.

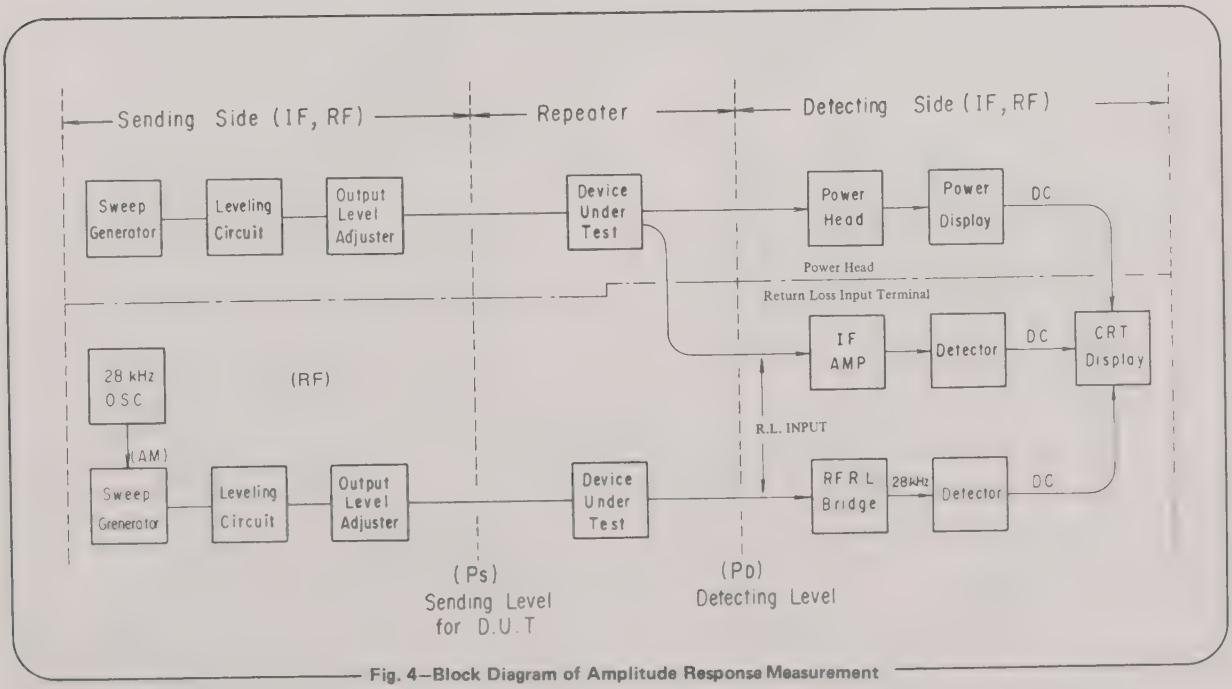


Fig. 4—Block Diagram of Amplitude Response Measurement

Table B—Available Sweep Width

SWEEP MHz (70) switch	Available Sweep Width
±2MHz	not available, fixed
±10MHz	±4 to ±10MHz
±15MHz	±9 to ±15MHz
±20MHz	±14 to ±20MHz

(c) Sending level (P_S):

Calibrated sending level from +10 to −60dBm with 1dB resolution is obtained by setting the output step attenuator on the front panel. 10dB of continuous variable level control is provided on the front panel.

3.03 *RF Sending Side:* Some of the three Sending Side sections shown in Fig. 4 are contained in the MRTS Sending Unit. Other sections are set up with ancillary equipment.

(a) Center frequency (f_O):

Frequencies required for repeater analysis at 2, 4, 6 and 11GHz bands are obtained with 100kHz resolution using the thumb wheel switch on the front panel.

(b) Sweep width (ΔF):
Selects ΔSWEEP MHz (70).
Refer to "IF Sending Side" (b).

(c) Sending level (P_S):

The leveling circuit is a combination of the MRTS Sending Unit and directional detector of furnished ancillary equipment. Leveled power output is continuously set in the range of +10 to 0dBm (for 2, 4 and 6GHz bands), +5 to −5dBm (for 11GHz band) using the RF level control on the front panel. When a lower output level than that above is required, pads of ancillary equipment should be connected to the RF output terminal of the directional detector. Then, the RF sending level can be set to −60dBm.

3.04 *IF Detecting Side:* The detector and CRT display shown in Fig. 4 are contained in the MRTS Displaying Unit.

If the IF Power Head is used, amplitude response can be observed on the CRT screen. The absolute power level (average power of the sweep signal) can be measured on the power digital display simultaneously.

If an amplitude response measurement of more than 8dB full scale on the CRT screen is required, a response measurement with a larger dynamic range of 20dB full scale (2.5dB/DIV.) can be made with the IF return loss input

Table C—Detector Configuration Selection Guide

Item No.	Description	Detecting Level Range	CRT Screen Range	Simultaneous Measurement of Ampl.* and Power	Remarks
1	IF Power Head	+12 to −12dBm	0.05, 0.1, 0.5 and 1dB per div.	Yes	IF Power Head connected externally
2	IF Return Loss input terminal	(A) −16 to −36dBm (B) −26 to −46dBm (C) −36 to −56dBm	2.5dB per div.	No	(A) RANGE 0−20dB (B) RANGE 10−30dB (C) RANGE 20−40dB (Item 3.06)
3	RF Power Head	+10 to −10dBm	0.1, 0.5 and 1dB per div.	Yes	RF Power Head connected externally
4	RF Return Loss Bridge	(A) −5 to −25dBm (B) −15 to −35dBm	2.5dB per div.	No	(A) RANGE 0−20dB (B) RANGE 10−30dB RF Return Loss Bridge connected externally (Item 3.07)

* Amplitude Response

terminal.
These relations are shown in Table C.

3.05 In the amplitude response measurement, depending on item 2, in which the IF return loss measurement function is used, the IF Return Loss input signal is amplified and detected to DC. Therefore, this measuring method is suitable for very low amplitude test signals. The inherent amplitude slope (approx. 0.5dB/±20MHz) due to the IF amplifier and IF Detector must be added to the measuring error.

3.06 ***RF Detecting Side:*** The detector shown in Fig. 4 is contained in the Ancillary Equipment, not in the MRTS main units.
If the RF power head is used, amplitude response and absolute power can be measured at the same time, as well as IF power measurement.
If the return loss bridge is used, amplitude response can be measured at 20dB full scale (2.5dB/DIV) on the CRT screen. These relations are shown in Table C.

3.07 In the amplitude response measurements, depending on item 4, in which the RF return loss measurement function is used, the source signal is amplitude-modulated by apprximately 28kHz as shown in Fig. 4.
This method is used in order to obtain a stable display on the CRT even if the detecting level is very low. If the devices under measurement are active components and are saturated by high signal input levels, the measurements may be inaccurate.

B. IF to IF Amplitude Response Measurement

3.08 ***Calibration:*** See Section 2, 3, G.

3.09 When minimizing the inherent slope (flatness) using the IF SLOPE ADJUST control (66), more accurate slope adjustment can be achieved by setting the IF LEVEL VERNIER control (64) to the position of the level in actual use before adjusting IF SLOPE ADJUST (66).

3.10 Two types of attenuators to change the power output level are available in the IF sweep generator. One of these attenuators is IF LEVEL VERNIER (64), which can vary 10dB continuously, and the other is IF LEVEL dBm (63), which can vary 70dB in 1dB steps. When IF LEVEL VERNIER (64) is set to final clockwise position, the power output level can be read directly from the IF LEVEL dBm setting. That is, a +10 to –60dBm range can be set at a resolution of 1dB.

3.11 Since the change of flatness is 0.01dB or less, even when the IF LEVEL dBm step attenuator is adjusted, this attenuator has little effect on the flatness calibration already performed.

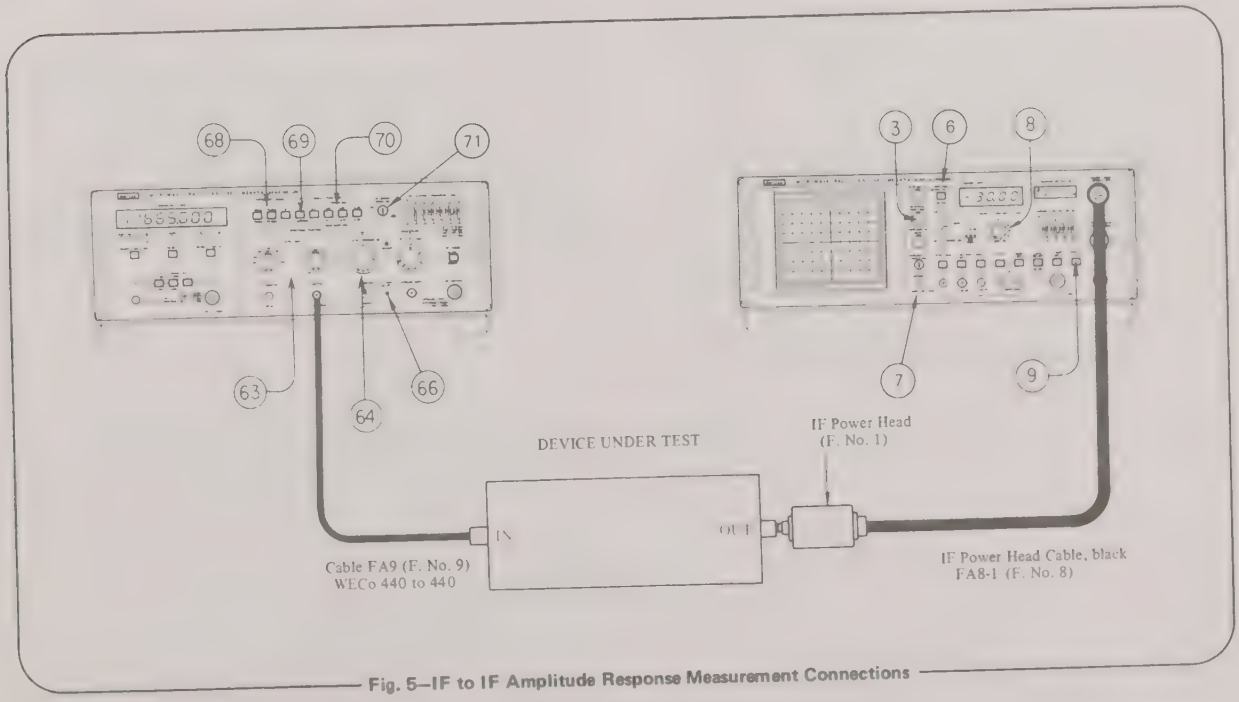


Fig. 5—IF to IF Amplitude Response Measurement Connections

3.12 *Measuring Procedure:* Connections are shown in Fig. 5.
Set the controls as follows.

STEP	PROCEDURE
1	Select IF 70MHz or 74.1MHz (68) according to the system under test.
2	Select the appropriate ΔF SWEEP MHz (70), and ΔF SWEEP VERNIER (71), depending on the system under test.
3	Set to the required sending level with IF LEVEL VERNIER (64) and IF LEVEL dBm (63).
4	Push AMPL/POWER IF (9).
5	Select VERTICAL SENSITIVITY (6) 0.05dB/DIV., 0.1dB/DIV. or 1dB/DIV. according to the amplitude response under test.
6	Select MARKER FREQUENCY (8) 0 to ±20MHz.
7	Push HORIZONTAL (39) (Rear Panel) ..... INT.
8	Push VERTICAL (41) (Rear Panel) ..... INT, AC.
9	Adjust VERTICAL POSITION (3) to set the amplitude response image on the CRT to a position where it can be observed easy.
10	Read the amplitude response on the CRT.

3.13 *Measured Result:* The level of the displayed image is read from the CRT at the setting sensitivity.

3.14 When VERTICAL axis is coupled to DC, the image can be shifted to the center of the CRT by pushing the OFFSET (7) switch.
The DC coupling vertical signal is available in order to simultaneously observe amplitude and loss changing during device adjustments and operation.

C. RF to RF Amplitude Response Measurement

3.15 *Calibration:* When measuring RF to RF amplitude response, connect the MRTS and the repeater under test as shown in Fig. 6. Refer to item 1 for power measurement.

Caution: Static discharge can damage the detector element. Connect the leveling cable to the LEVELER INPUT jack of the sending unit before connecting the Directional Detector.

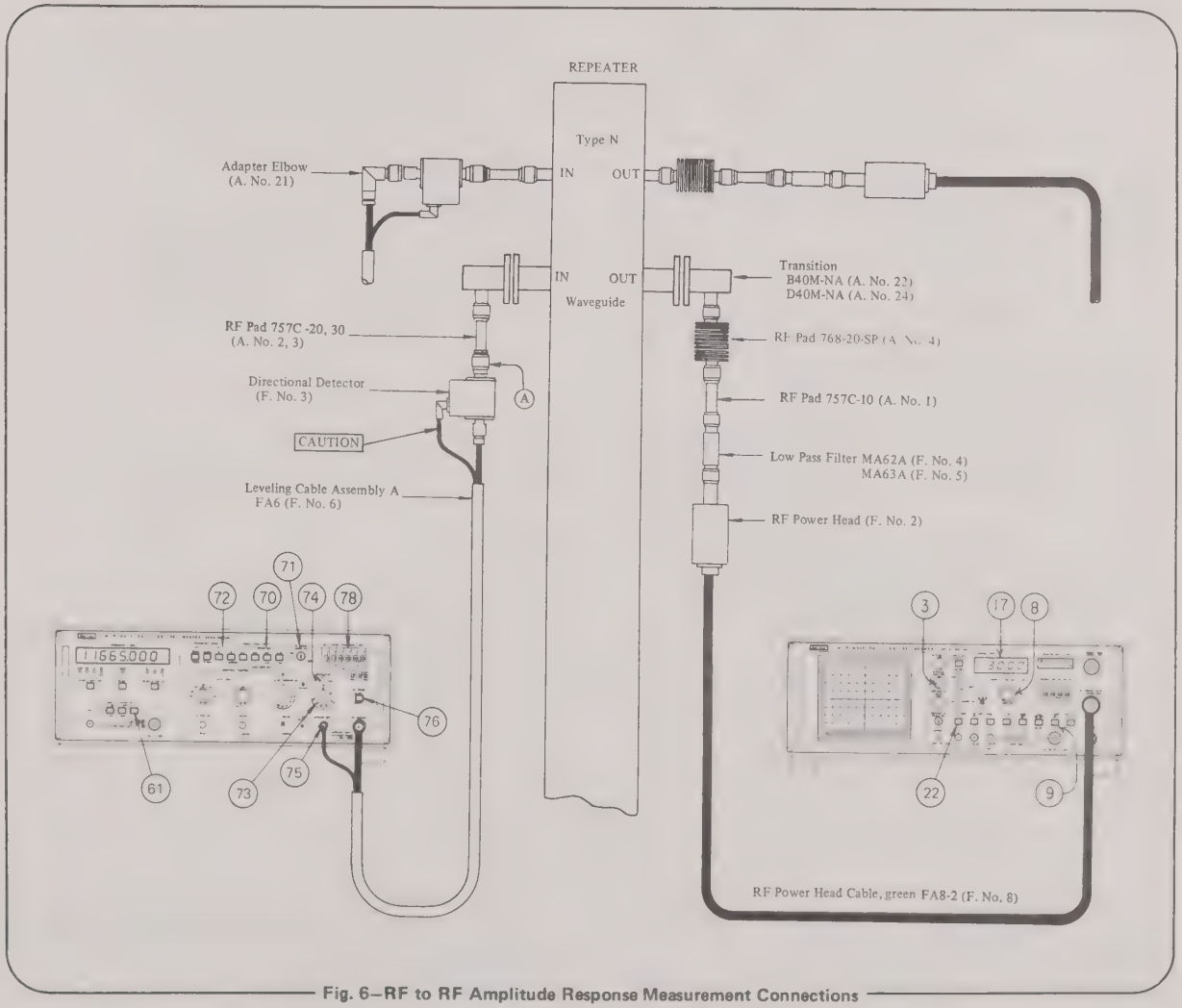


Fig. 6–RF to RF Amplitude Response Measurement Connections

3.16 *Measuring Procedure:*

STEP	PROCEDURE
1	Set the output frequency with RF CENTER MHz (78) . Refer to item 3.17. RF CENTER FREQUENCY MHz 0 6 2 5 6 .5 6256.5MHz
2	Push RF switch (72) .
3	Select the appropriate ΔF SWEEP (70) , (71) , push ±15MHz switch, for instance.
4	Push the RF POWER (76) ..... ON
5	Adjust the output level. Refer to item 3.18.
6	Push AMPL/POWER RF (9).
7	Push HORIZONTAL (39) (Rear panel) ..... INT.
8	Push VERTICAL (41) (Rear panel) ..... INT, AC.
9	Select VERTICAL SENSITIVITY to 0.1, 0.5 or 1dB/DIV.
10	Select MARKER FREQUENCY (8). Set to ±15MHz, for instance.
11	Adjust VERTICAL POSITION (3) to set the amplitude response image on the CRT to a position where it can be observed easy.
12	Read the amplitude response on the CRT.

3.17 ***Frequency Jump:*** To switch the RF output frequency, set the RF POWER switch to OFF and set the RF CENTER FREQUENCY switch.
Frequency jump occurs under two conditions described below.

(a) When switching the frequency from 4,200.0MHz to 4,199.9MHz, for example, the frequency difference is 100kHz.
Whether switching a frequency by 10MHz or 100MHz, the frequency difference is approximately 100MHz.

(b) The RF CENTER FREQUENCY switch is a thumbwheel switch that sets the value which is different from the numerals on both sides in its structure. For example, 0 may be set between 7 and 8. The MRTS is designed to compensate for this fault. When switching the thumbwheel switch in approximately two seconds or more per step, or when the switch suddenly stops (which hardly stops under normal conditions), a frequency jump may occur within the digit.

(c) In case of changing the RF center frequency, thumbwheel switch should be changed by one figure. If changed more than two figures at one time, the output frequency may not be set correctly.

For these reasons, change the frequency setting as follows.

[Frequency setting] → [RF Power ON] → [RF Power OFF] → [Change the frequency setting] → [RF Power ON] → [RF Power OFF] → [Change the frequency setting] → [RF Power ON]

3.18 Output level

(a) Leveled power:
Leveled power at point (A) in Fig. 6 is +10 to 0dBm in the 2, 4 and 6GHz bands, and +5 to −5dBm in the 11GHz band.

(b) UNLEVELED lmap (74):
This lamp lights when the leveling function stops because the power output exceeds the above level when RF LEVEL ADJUST (73) is turned clockwise. In addition to the above condition, the UNLEVELED lamp (74) lights under the following conditions:

(1) When RF CENTER FREQUENCY MHz (78) is out of the band,

(2) When FREQUENCY BAND IF (78) is pushed,

(3) When RF POWER (76) is OFF,

(4) When LEVELER INPUT (75) is not connected,

(5) When RF (61) is pushed,

(6) When SPECTRUM (22) is pushed.

Note that this lamp does not light when the leveling function stops because the power output has dropped to −10dBm, or less when RF LEVEL ADJUST is turned counterclockwise.

(c) Output level
To accurately find the RF level at point (A) in Fig. 6, use an RF power head. See item 3, J of Section 2. When an RF level of 0dBm or less is necessary, connect pads (A. Nos. 1 to 3) to point (A) of Fig. 6. The power can be set from 0 to −60dBm in 10dB steps by connecting these pads.

3.19 ***When the Output RF Level is +10 to −30dBm; −25dBm for example:*** In this case, the output level can be set directly by the RF power meter as follows:

STEP	PROCEDURE
1	Connect 30dB pad Model 757C-30 and adapter (Model 77 N(F) to N(F)) to the output terminal of the directional detector.
2	Connect the RF power head to the adapter.
3	Push AMPL/POWER RF (9).
4	Monitor RF power on the POWER dBm digital display (17).
5	Set RF LEVEL ADJUST (73) to obtain a value of −25dBm on the digital display. The output level is calibrated by this procedure.

3.20 ***When the Required Output RF Level is −30dBm or Less; −35dBm for example:*** Since the measurement range of the RF power meter is −30 to +10dBm, the following calibration is necessary:

(a) Use a 10dB and 30dB pads from available ancillary equipment.

(b) Find the actual attenuation corresponding to the output frequency from the calibration curve on the 10 and 30dB pads; 39.8dB, for example.

(c) Calculate the proper level at the directional detector output terminal. In this case, the level is calculated as follows:

$$-35 - (-39.8) = +4.8\text{dBm}$$

(d) Connect the RF power head to the directional detector and set the level to +4.8dBm by RF LEVEL ADJUST (73).

(e) Disconnect the RF power head from the directional detector and connect the 10 and 30dB pads (Actual attenuation is 39.8dB at this frequency). The output level of −35dBm is calibrated by this procedure.

3.21 ***Detecting Level:*** The detecting level range differs depending on the configuration of the detecting side as shown in Table C.
Since the output level of the repeater also differs depending on the radio system, the pads (High power, 20dB,10dB) connected to the repeater output terminal must be selected according to the relationship between these levels.
The connection in Fig. 6 is an example using the RF power head. The absolute output level and amplitude response of the repeater can be measured simultaneously.
Refer to item 1.08 for measurement of absolute output level.

3.22 ***Measured Result:*** Example of RF to RF amplitude response measurement.

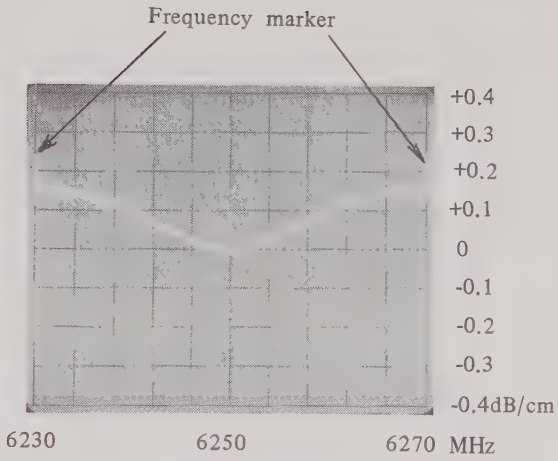


Fig. 7—RF Amplitude Response

(a) RF output center frequency: 6250MHz
(b) ΔF SWEEP: ±20MHz
(c) Detected level: +4.2dBm
(d) Actual attenuation of detecting side: 30.8dB (nominal 20+10=30dB)
(e) Repeater input level: −25dBm
(f) Repeater output level: +35dBm
(g) Overall amplitude response: 0.15dB/±20MHz

3.23 The full scale levels on the CRT are 0.8dB, 4dB and 8dB. When measuring a higher amplitude response (for instance, 20dB/±20MHz), use the RF Return Loss Bridge and RETURN LOSS RF INPUT (19) as shown in Fig. 4 and Table C. Panel operations are in detail described in item 4, B.

D. IF to RF Amplitude Response Measurement

3.24 This measurement is a practical application of the measurement methods of item 3, B IF to IF and item 3, C RF to RF amplitude response measurement. Refer to item 3, B for the output side (IF) and to item 3, C for the detecting side (RF).

E. RF to IF Amplitude Response Measurement

3.25 This measurement is a practical application of the measurement methods of item 3, B IF to IF and item 3, C RF to RF amplitude response measurement. Refer to item 3, C for the output side (RF) and to item 3, B for the detecting side (IF).

4. RETURN LOSS MEASUREMENT

A. IF Return Loss Measurement

4.01 MR54A IF Return Loss Bridge (A. No. 35) must be used to measure IF return loss. The measurement procedure is as follows:

4.02 *Calibration:* Connection is shown in Fig. 8. Set the controls as follows:

STEP	PROCEDURE
1	Push IF 70MHz or 74.1MHz (68), according to the system under test.
2	Select the appropriate ΔF SWEEP MHz (70).
3	Connect the X terminal of MR54A to the IF Power Head through adapter MA58A (WECo 560 to 560 (A. No. 18)).
4	Push AMPL/POWER IF (9).
5	Adjust IF LEVEL dBm (63) and IF LEVEL VERNIER (64) to indicate 10dBm on digital display (17).
6	Disconnect the IF Power Head and connect the X terminal of MR54A to IF MISMATCH 20dB (67).
7	Push RETURN LOSS IF (20) ..... VERTICAL SENSITIVITY 2.5dB lamp should light.
8	Select the appropriate MARKER (8).
9	Push HORIZONTAL (39) (on rear panel) ..... INT
10	Push VERTICAL (41) (on rear panel) ..... INT
11	Set RANGE dB (26) 10-30
12	Adjust VERTICAL POSITION (3) to set the CRT trace to the center graticule.
13	Adjust HORIZONTAL GAIN (4) to set the CRT trace to fill the horizontal axis scale.

4.03 The above completes calibration of the IF return loss measurement.

Next, perform measurement as follows:

4.04 *Measuring Procedure:* Disconnect the previously connected X terminal of MR54A IF Return Loss Bridge from IF MISMATCH 20dB (67), and connect this X terminal to the device under test. If the connector of the device under test is a WECo 477, insert adapter MP533A (WECo 358 to 560 (A. No. 16)) between the device under test and the X terminal of the MR54A IF Return Loss Bridge.

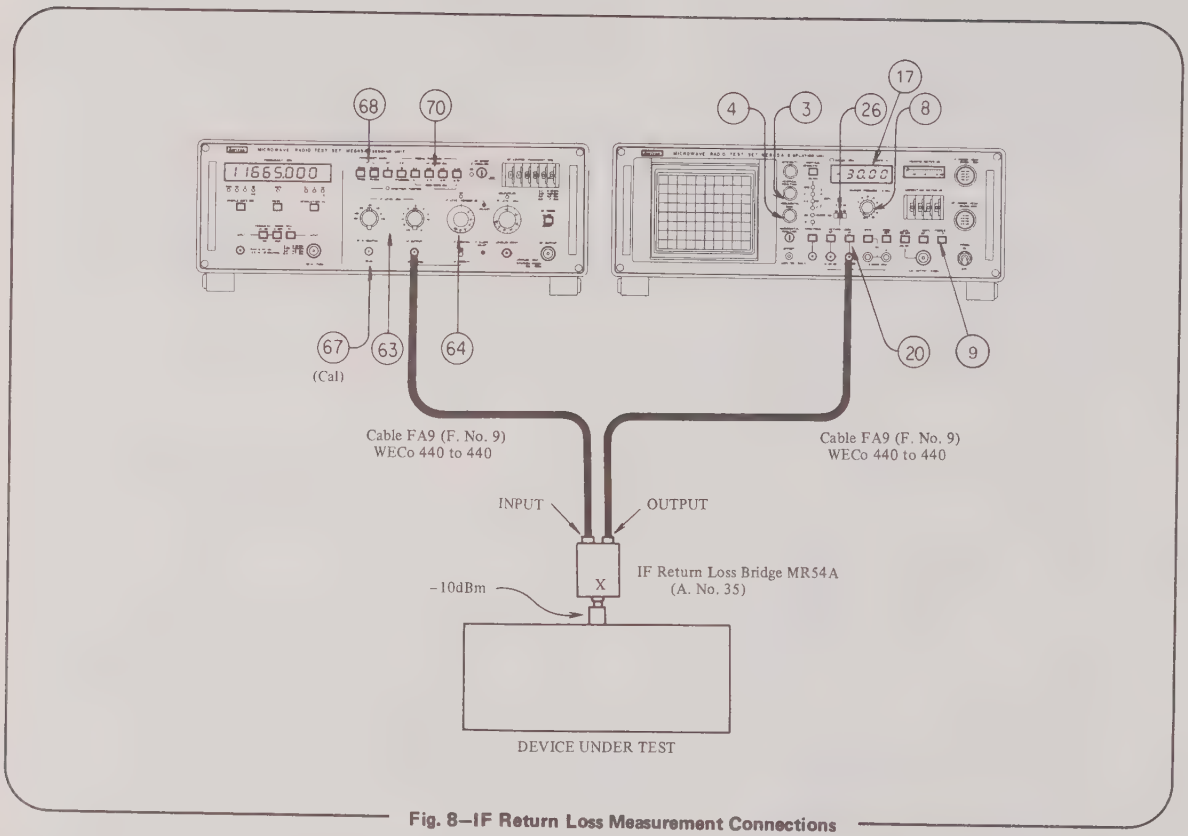
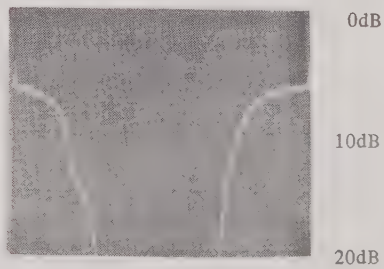


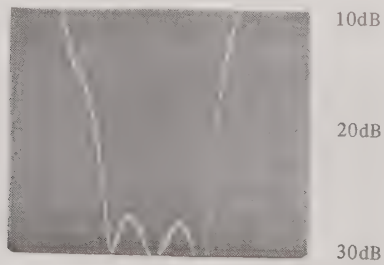
Fig. 8—IF Return Loss Measurement Connections

4.05 *Measured Result:* During the IF return loss measurement, the CRT vertical axis sensitivity should be 2.5dB/DIV. One of 3 measuring ranges (0 to 20dB, 10 to 30dB, 20 to 40dB) can be selected using RANGE dB (26). As a result of the previous calibration, the center graticule corresponds to a return loss of 20dB, the top and bottom graticules correspond to return losses of 10dB and 30dB respectively.

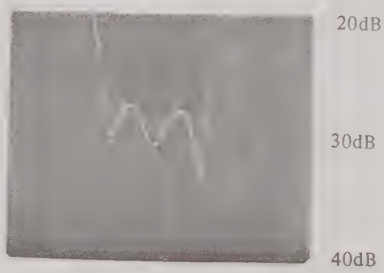
Examples of measuring results show in Fig. 9. In Fig. 9(a) the center graticule corresponds to a return loss of 20dB, in Fig. 9(b) corresponds to 10dB and in Fig. 9(c) corresponds to 30dB respectively.



(b) 0 - 20 dB range



(a) 10 - 30dB range



(c) 20 - 40dB range

Fig. 9—Examples of Measured Results

4.06 *Accuracy:* The accuracy of the measured IF return loss is as follows: (with MR54A)

Table D—IF Return Loss Accuracy

Range	Accuracy
0 – 10dB	2dB
10 – 30dB	1dB
30 – 40dB	2dB

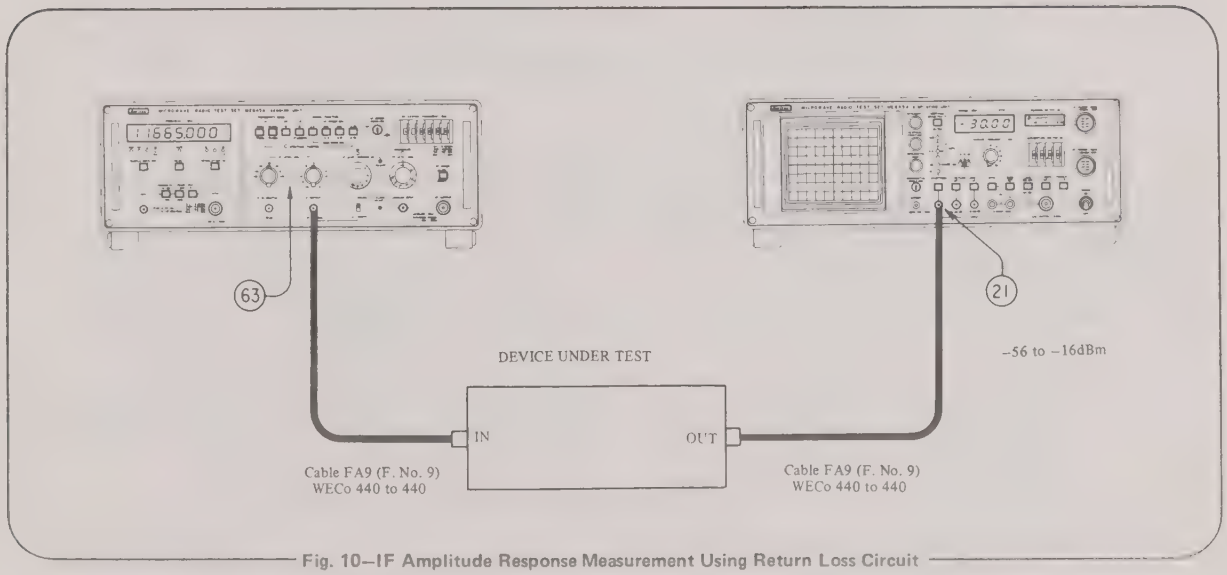


Fig. 10—IF Amplitude Response Measurement Using Return Loss Circuit

4.07 *Application to amplitude response measurement:*

The IF to IF amplitude response measurement using the IF Power Head is described in item 3, B. This is at CRT full scale 8dB (1dB/DIV).

When measuring amplitude characteristics of 8dB or greater, coarse measurement is possible.

At this time, low level measurement (greater than −56 dBm) is also possible.

Connections are shown in Fig. 10. The operating procedure is identical to that described for calibration, except for the following points:

Note: (a) MR54A IF Return Loss Bridge is not used.

(b) Adjust IF LEVEL (63) so that an input level of about −50dBm (return loss range: 20 - 40dB) is obtained at the input terminal of IF RETURN LOSS (21).
At this time, the amplitude characteristic of the device under test will be displayed on the CRT, and can be measured at a vertical sensitivity of 2.5dB/DIV. (full scale 20dB).

(c) See item 3.05.

(d) Note that if a steep amplitude response of more than 30dB is measured, the response may be delayed.

B. RF Return Loss Measurement

4.08 The RF Return Loss Bridge SP2369 (A. No. 36) must be used to measure RF return loss. The measurement procedure is as follows:

4.09 *Calibration:* Connection is shown in Fig. 11. Set the controls as follows:

STEP	PROCEDURE
1	Push RF switch (72) ..... ON
2	Set RF CENTER FREQUENCY MHz (78) to the required frequency.
3	Select the appropriate ΔF SWEEP MHz (70).
4	Connect the test port of the RF Return Loss Bridge to the RF Power Head with the adapter 34AN50 (7mm to N(M): A. No. 36) and the adapter 77 (N(F) to N(F): A. No. 20).
5	Push RF POWER (76) ..... ON
6	Set the port output level to −5dBm ±1dB by the RF LEVEL ADJUST (73).
7	Connect the RF Return Loss Bridge test port to the Fixed short 5230 (A. No. 36), and connect the Coaxial Attenuator 20dB (A. No. 2) between the Directional Detector and the RF Return Loss Bridge as shown in Fig. 11.
8	Push RETURN LOSS RF (18) ..... VERTICAL SENSITIVITY 2.5dB lamp lights.
9	Select the appropriate MARKER (8).
10	Push HORIZONTAL (39) (on rear panel) ..... INT
11	Push VERTICAL (41) (on rear panel) ..... INT
12	Set RANGE dB (26) ..... 10 - 30
13	Adjust VERTICAL POSITION (3) to set the CRT trace on the center graticule. See Note.
14	Adjust HORIZONTAL GAIN (4) to set the CRT trace so that it fills the horizontal axis scale.
	Note: After completing step 13, perform calibration as follows: (a) Open the test port of the RF return loss bridge. (b) Read the deviation from the center of the CRT. (c) Correct one half of the deviation for Step (b) using the VERTICAL POSITION (3) switch.

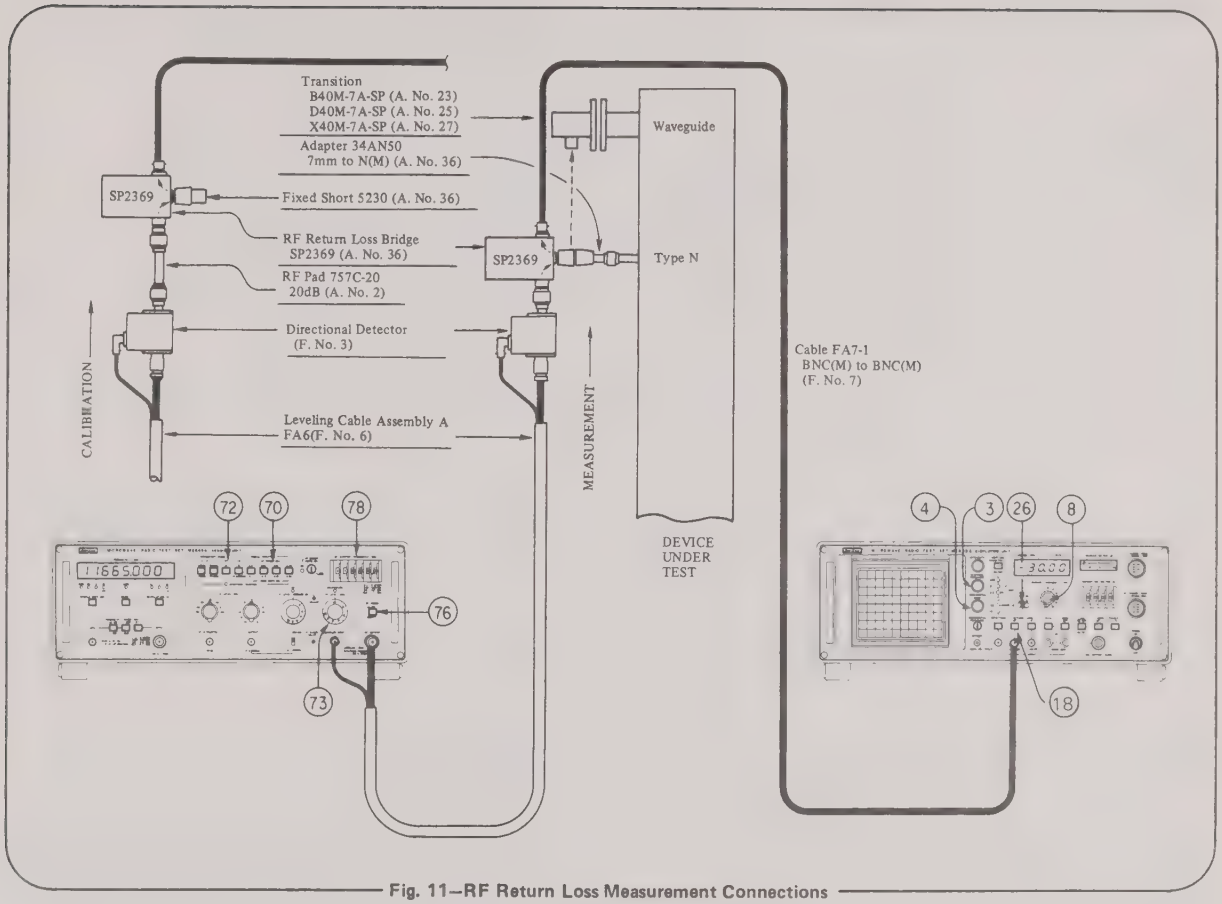


Fig. 11—RF Return Loss Measurement Connections

4.10 The above completes calibration of the RF return loss measurement.

4.11 *Measuring Procedure:* Perform measurement as follows:

STEP	PROCEDURE
1	Disconnect the fixed short 5230 (A. No. 36) from the RF Return Loss Bridge test port.
2	Disconnect the attenuator 20dB (A. No. 2) connected between the Directional Detector and the RF Return Loss Bridge.
3	Connect the RF Return Loss Bridge input port directly to the output terminal of the Directional Detector.
4	4, 6GHz bands: Connect the RF Return Loss Bridge test port to the transistion connected to the repeater test point. 2, 11GHz bands: Connect the RF Return Loss Bridge test port to the adapter 34AN50 (A. No. 36) connected to the repeater test point.

4.12 *Measured Result:* See MEASURED RESULT of item 4, A, except for the following points:

Note: For RF return loss measurement, 2 ranges (0 to 20dB, 10 to 30dB) can be selected.

4.13 *Application to Amplitude Response Measurement:* The RF to RF amplitude response measurement using the RF Power Head is described in item 3, C. This is at CRT full scale 8dB (1dB/DIV.). When measuring amplitude characteristics of 8dB or greater, coarse measurement is possible.
At that time, low level measurement (greater than –35 dBm) is also possible.
Connections are shown in Fig. 12. The operating procedure is identical to the calibration procedure, except for the following points:

Note: Insert an attenuator between the directional detector output and input of the device under test so that an input level of about –25dBm (return loss range: 10 – 30dB) is obtained at the RF Return Loss Bridge test port.

At this time, the amplitude characteristic of the device under test will be displayed on the CRT. This amplitude can be measured at a vertical sensitivity of 2.5dB/DIV. (full scale 20dB).

Note: See item 3.07.

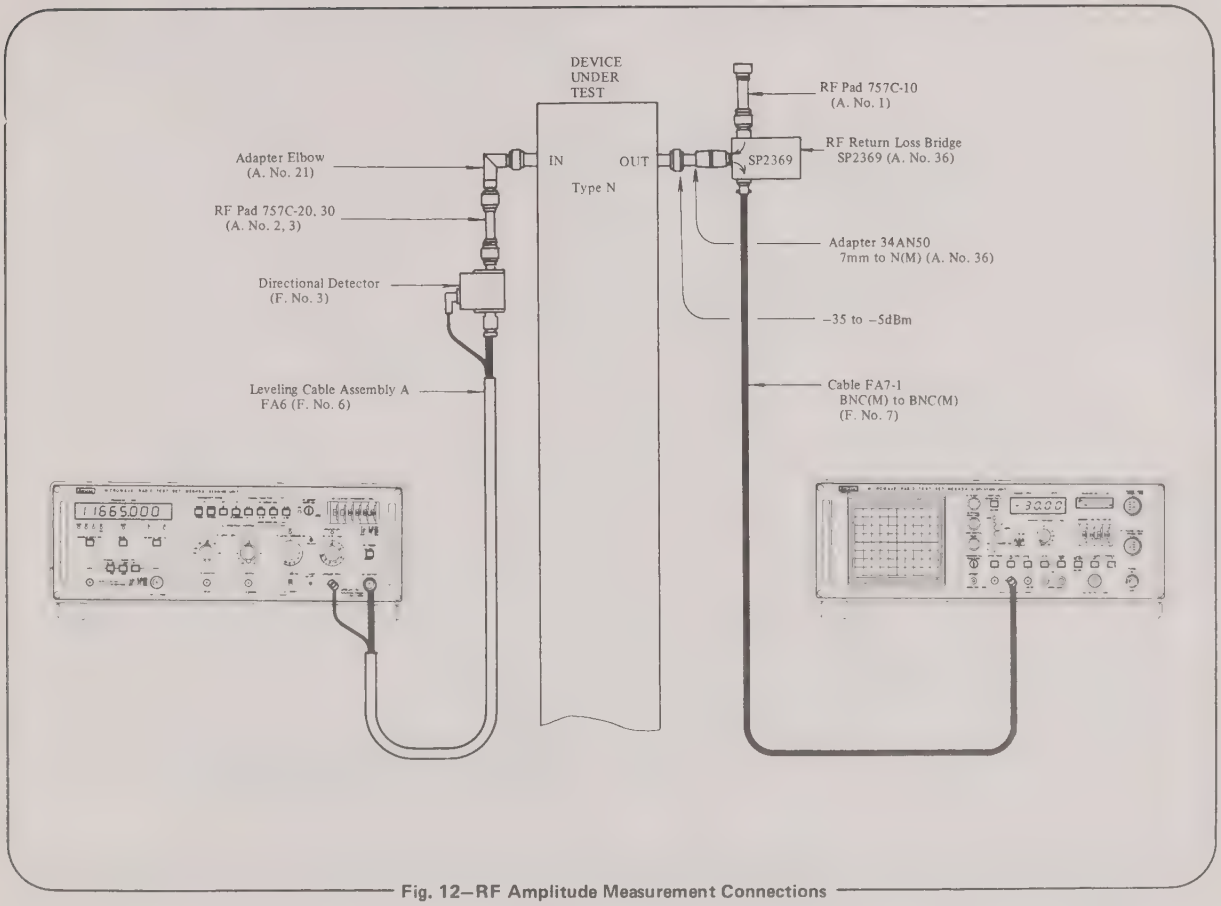


Fig. 12—RF Amplitude Measurement Connections

5. RECEIVER NOISE FIGURE MEASUREMENT

5.01 The noise figure test (RF to IF) is performed on the microwave receiver in order to detect thermal noise degradation.

Receiver noise figures can be expected to range from 5 to 15dB.

The measuring method described here is called the signal generator methods.

The equipment required for measurement is shown in Fig. 13.

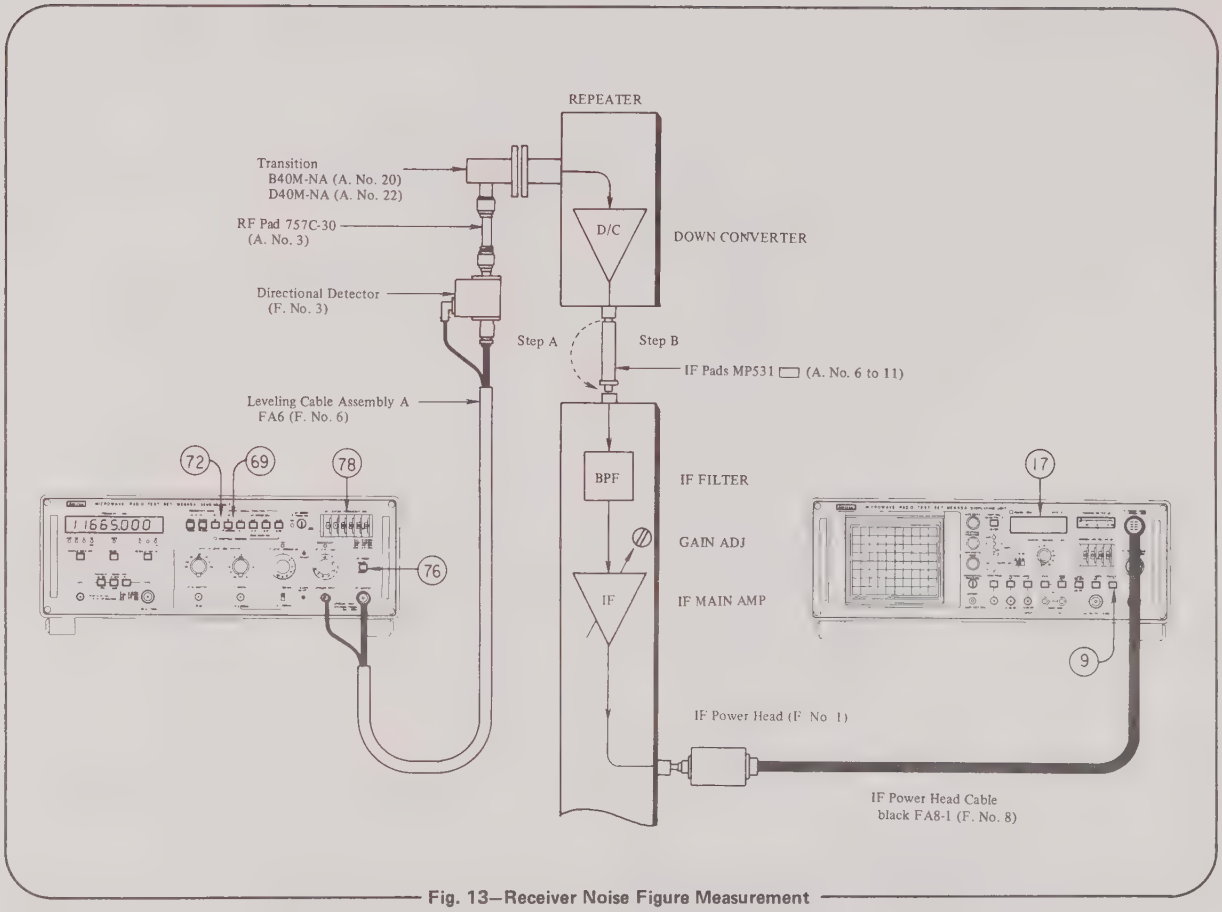


Fig. 13—Receiver Noise Figure Measurement

5.02 *Calibration:*

STEP	PROCEDURE
1	Set RF CENTER FREQUENCY (78) to the frequency of the receiver under test.
2	Push RF switch (72).
3	Push CW switch (69).
4	Push RF POWER (76) ..... ON
5	Calibrate IF and RF power meter (See item 1.)
6	Adjust the RF output power to –30dBm at the 30dB pad output terminal. (See item 3.19) ..... Ps (RF Power Source Level)

5.03 *Measuring Procedure:* Release the AGC circuit of the repeater under test before measuring the noise figure.

(a) The connection is shown by the dotted line in Fig. 13.

STEP	PROCEDURE
1	Push AMPL/POWER IF (9).
2	Push RF (72).
3	Push CW (69).
4	Set RF POWER (76) OFF position.
5	Read POWER dBm (17) on the digital display, P1 (ex. –15dBm).

(b) The connection is shown by solid lines in Fig. 13.

STEP	PROCEDURE
1	Insert IF pads 60dB (35, 15 and 10dB) between the down converter and the IF filter (B.P.F.).
2	Push RF POWER (76) ..... ON
3	Read POWER dBm (17) on digital display, P2 (ex. –5dBm).

5.04 If Power P2 increases over –5dBm, replace the IF pads to reduce the power P2 to less than –5dBm.

5.05 *Measured Result:* The Noise Figure can be calculated from P1, P2, IF pad attenuation, and the equivalent noise band of the repeater under test.

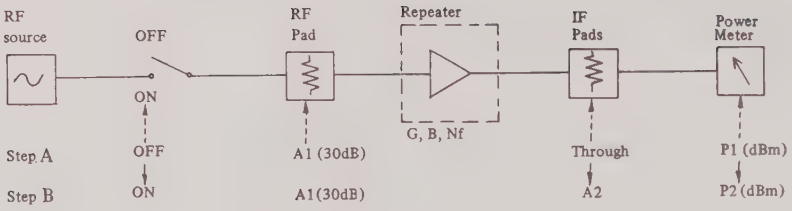


Fig. 14—Simplified Receiver Noise Figure Measurement Block Diagram

5.06 The Noise Figure Nf of the repeater (receiver) is obtained from the following equation.

$$Nf = \frac{1}{kTB} \cdot \frac{Ps}{A} \cdot \frac{P1}{P2}$$

Where, k : Boltzmann's Constant (1.38×10^{-23})
T: : Absolute Temperature (°K)
B : Effective Noise Band Width (Hz)
Ps : RF Source Level
A : IF Pad Attenuation
P1 : IF Output Level of Step A
P2 : IF Output Level of Step B

$$Nf(dB) = -10 \log_{10}[kTB \cdot 10^3] + Ps(dBm) - A(dB) + P1(dBm) - P2(dBm)$$

Example:
B = 3MHz (kTB = –109dBm), Ps = –30dBm
A = 60dB, P1 = –15dBm, P2 = –5dBm
Nf = 109 – 30 – 60 –15 +5 = 9dB

6. CARRIER RESUPPLY MEASUREMENT

6.01 The carrier resupply operates by continuously reducing the input signal to the receiver until the carrier resupply trip (operate) point is reached.
When the carrier resupply operates, two simultaneous signals are generated;
(1) 70MHz (or 74.1MHz) IF carrier and, (2) a lower sideband signal of 61MHz (or 65.1MHz) at a level approximately 35 to 45dB below the IF carrier signal.

6.02 *Calibration:* Calibrate the IF power meter. (See item 3, E of Section 2).

6.03 *Measuring Procedure:*

(a) Carrier Power and Frequency Test

STEP	PROCEDURE
1	Connect the devices as shown in Fig. 15 (Step A).
2	Push FREQUENCY RANGE MHz 14 – 300MHz (54).
3	Push AMPL/POWER IF (9).
4	Read FREQUENCY (51). 70MHz should be read in the 70MHz system. 74.12965MHz should be read in the 74.1MHz system.
5	Connect the BPF output terminal to the IF power head: Read IF power (17).

(b) Pilot Power and Frequency Test

STEP	PROCEDURE
1	Connect the devices as shown in Fig. 15 (Step B).
2	Read FREQUENCY (51). 61MHz should be read in the 70MHz system.
3	Connect the BPF output terminal to the IF power head: Read pilot power.

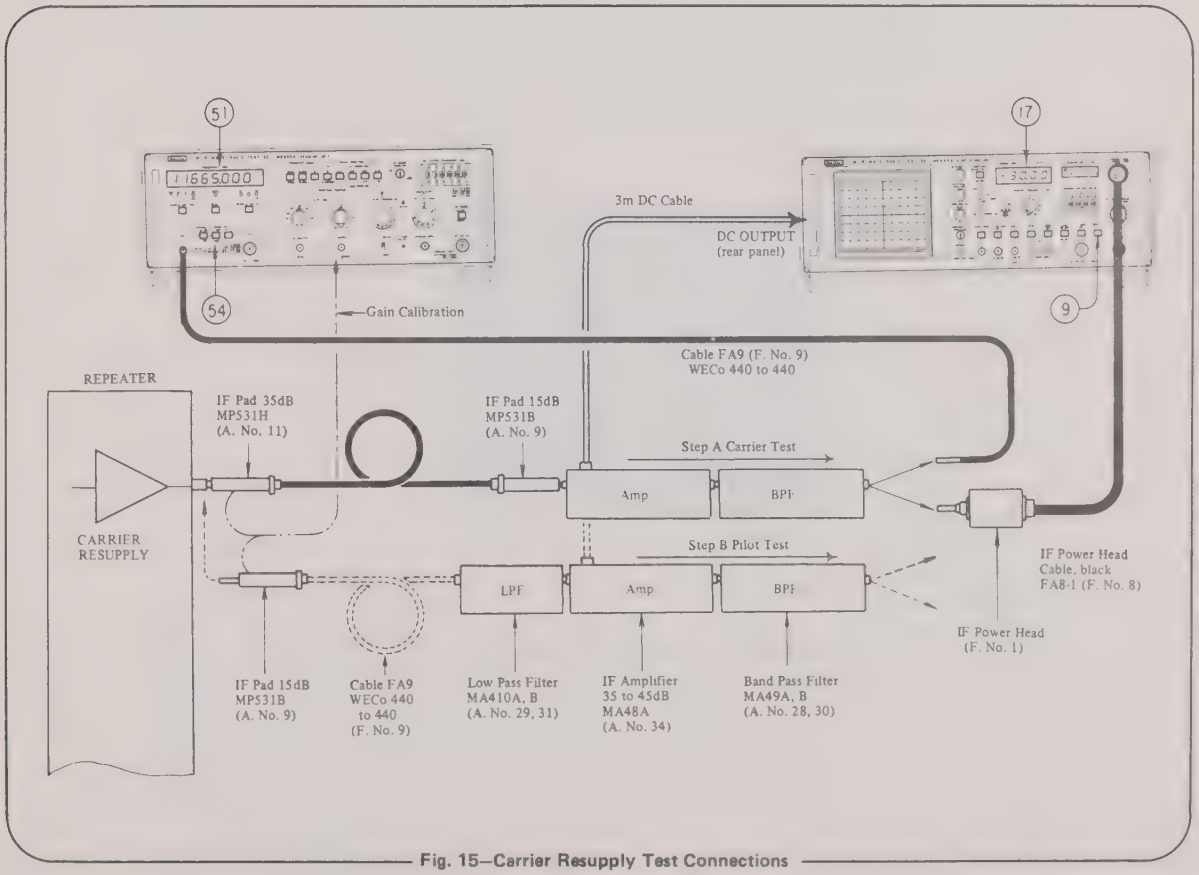


Fig. 15—Carrier Resupply Test Connections

6.04 The above measuring data should be compared to the given specifications to check transmission system performance.
Different transmission systems have their own specifications.
Refer to the individual instruction manuals for the proper transmission system.

6.05 The IF Amplifier MA48A (A. No. 34) gain in use here can be varied from 35 to 45dB.
The gain of the IF amplifier is determined by the repeater system.
BPF and LPF characteristics are indicated on them.

6.06 BPF and LPF loss slightly change with temperature. More accurate power measurements can be made by using the following methods.

(a) ***Carrier Power Measurement:*** After Carrier Power and Frequency Test (6.03 (a)) is completed.

STEP	PROCEDURE
1	Disconnect the IF pad 35dB with cable FA9 from the carrier resupply output.
2	Connect the IF pad 35dB to IF OUTPUT (65) of Sending Unit with cable FA9. (Indicated by the long-and-short dashed line in Fig. 15).
3	Push the 70 or 74.1MHz switch (68).
4	Push the CW switch (69).
5	Push the AMPL/POWER IF (9).
6	Connect the BPF output terminal to the IF Power Head.
7	Adjust the IF output level to match the power measured in 6.03 (a)–5.
8	Disconnect the IF Pad 35dB with cable FA9 from the IF OUTPUT (65).
9	Disconnect the IF Power Head from the BPF.
10	Connect the IF Power Head to IF OUTPUT (65).
11	Read the IF Power. This is the correct carrier power.

(b) Pilot Power Measurement: After Pilot Power and Frequency Test (6.03 (b)) is completed.

STEP	PROCEDURE
1	Set VERTICAL SENSITIVITY to 0.1dB/DIV.
2	Set MARKER FREQUENCY to ±9MHz.
3	Push VERTICAL (41) (Rear panel) ..... INT, DC
4	Push OFFSET (7).
5	Adjust VERTICAL POSITION (3) so that CRT traces the center of the screen. (Fig. 16)

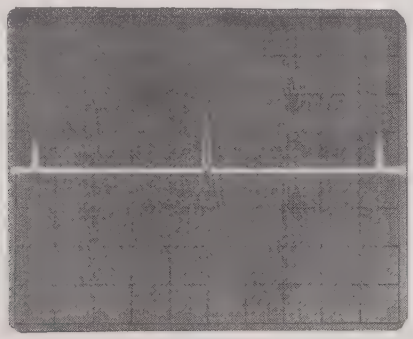


Fig. 16

6	Disconnect the IF Pad 15dB with cable FA9 from the Carrier Resupply output.
7	Connect the IF Pad 15dB to IF OUTPUT (65) with Cable FA9.
8	Push 70 or 74.1MHz (68).
9	Push ΔF SWEEP (70) ±10MHz.
10	Adjust both IF LEVEL (63) and IF LEVEL VERNIER (64) so that 61MHz or 65.1MHz crosses the center of the CRT. (Fig. 17)

STEP	PROCEDURE

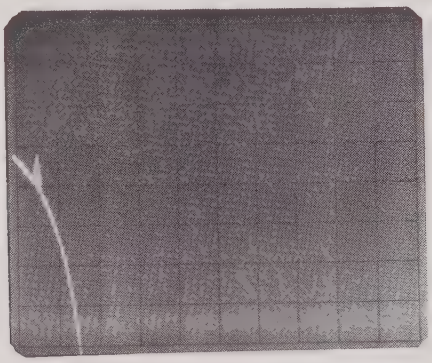


Fig. 17

11 Disconnect the IF PAD 15dB with cable FA9 from the IF OUTPUT (65) .

12 Disconnect the IF POWER HEAD from the BPF.

13 Connect the IF POWER HEAD to IF OUTPUT (65).

14 Read the IF Power.
This is equal to the Pilot Power.

The method used in (a) and (b) above to measure the power enable measurements with the accuracy of ±0.3dB at 0 to 50°C temperature ranges.

7. RF RECEIVER FADE MARGIN TEST

7.01 The microwave receiver RF fade margin test is conducted to evaluate the effect on overall radio system performance during reductions in received carrier power. The method described here inserts a loss between the transmitter amplifier and associated waveguide assembly of the preceding transmitter.

Warning: ***Do not misconnect the Coaxial Attenuator. A 20 watts high-power attenuator, Pad 768-20-SP (Pad 1) (A. No. 4) should be connected to the transmitter amplifier side, then a 2 watts attenuator, Pad 757C-20 (Pad 2) should be connected to Pad 1. If the connections are reversed, the 2 watts attenuator will burn out.***

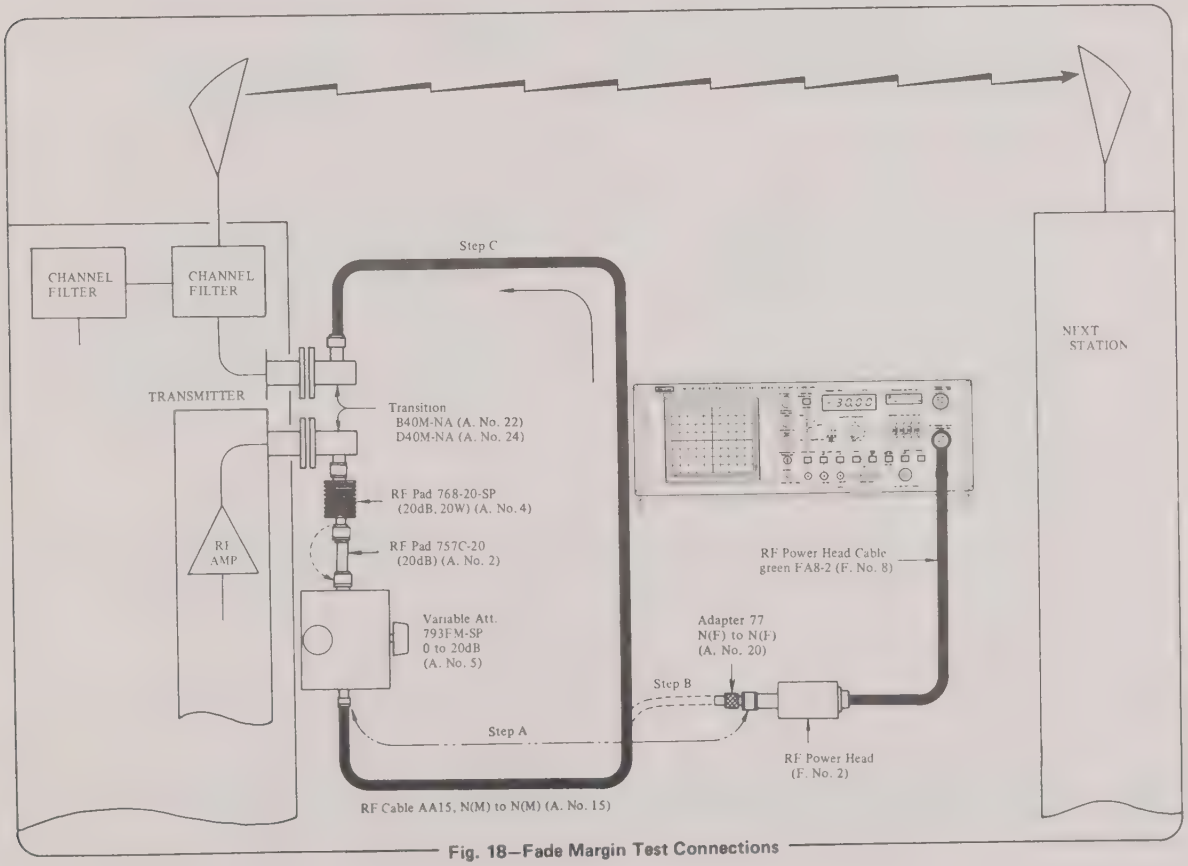


Fig. 18—Fade Margin Test Connections

7.02 *Calibration:*

STEP	PROCEDURE
1	Calculate and check that the output level supplied to the output waveguide assembly of the transmitter is suitable for the fade margin test of this radio relay system. (See Note)
2	If it is not suitable, the Pad 2 should be substituted for the 10dB pad, or the variable attenuator should be connected to Pad 1 directly.
3	Calibrate the MRTS RF power meter. (See item 3, D of Section 2.)
4	Connect the RF Power Head as shown in Fig. 18 Step A.
5	Read the RF Power → P1.
6	Disconnect the RF Power Head from the Variable Attenuator 793FM-SP.
7	Connect the RF Cable AA15 (A. No. 15) to the Variable Attenuator.
8	Connect the RF Cable AA15 to the Adapter 77 (A. No. 19).
9	Connect the RF Power Head to the Adapter 77 as shown in Fig. 18 Step B.
10	Read the RF Power → P2.
11	Calculate (P1-P2) → RF Cable Loss.
12	Make a calibration chart of the variable attenuator scale from 0 to 20dB versus the output level supplied to the output waveguide assembly of the transmitter, or refer to the chart if it has already been made.
	The above completes calibration for the fade margin test of the sending site.

Note: The power level range for the fade margin test differs between individual transmission systems. Refer to the Transmission Systems Instruction Manual concerning this power level range.

7.03 *Test Procedure:* Connection is shown in Fig. 18 Step C.

STEP	PROCEDURE
1	Set the attenuation to minimum on the variable attenuator. (Turn attenuator control fully counterclockwise.)
2	Inform the receiving site that test preparation has been finished and the sending level is now reduced.
3	Gradually turn the variable attenuator clockwise to reduce the sending level.
4	Contact the receiving station and stop step 3 at the moment the receiving side repeater begins its carrier resupply operation.

7.04 *Test Result:* Check that the repeater at the receiving station is correctly operating against the reduced signal from the results of the stated calibration above and step 4 of the test procedures.
For example, in the standard TH system, the carrier resupply function begins to operate at a level 25dB below the standard receiving level.

8. C/I MEASUREMENT

8.01 The MRTS can output a 70MHz (or 74.1MHz) ±300kHz signal for co-channel C/I measurement. (Fig. 19 MRTS I)

There are also 4 scan ranges in the MRTS for observation of the co-channel C/I transmission signal and cross-polarization discrimination (XPD). (Fig. 19 MRTS II)

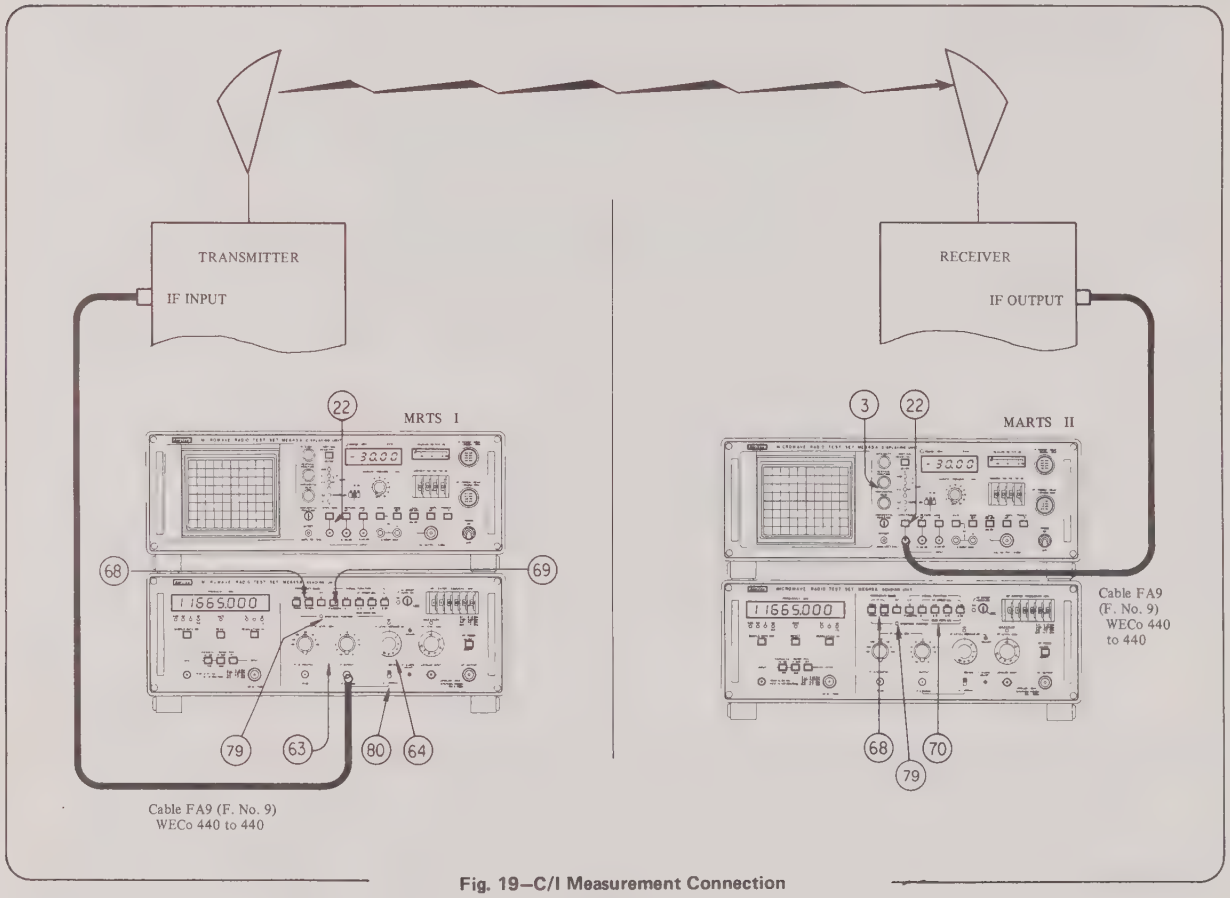


Fig. 19—C/I Measurement Connection

70MHz (or 74.1MHz) ±1MHz and ±5MHz . . . . for co-channel C/I measurement
70MHz (or 74.1MHz) ±15MHz and ±32MHz . . . . for XPD measurement

8.02 *Co-channel C/I Measuring Procedure:*

(a) Sending Side (MRTS I):

STEP	PROCEDURE
1	Push IF 70MHz (68) (or 74.1MHz (68)).
2	Push SPECTRUM (22), then set VERTICAL SENSITIVITY to 10dB/DIV, and observe SPECTRUM FUNCTION indicator (79) light.
3	Push IF ±300kHz (69).
4	Set switch (80) to IF +300kHz or IF −300kHz.
5	Adjust the IF LEVEL (63) or (64) to the corresponding level of the system under test.

(b) Receiving side (MRTS II):

STEP	PROCEDURE
1	Connect LOCAL OUTPUT (91) to LOCAL INPUT (45), by coaxial cable FA7-2 (F. No. 7) (rear panel).
2	Set VERTICAL (41) (rear panel) . . . . . INT, DC.
3	Set HORIZONTAL (39) (rear panel) . . . . . INT.
4	Push IF 70MHz (68) (or 74.1MHz (68))
5	Push SPECTRUM (22), vertical sensitivity 10dB/DIV lamp light, and observe SPECTRUM FUNCTION (79) indicator light.
6	Push SCAN WIDTH MHz (70) ±1MHz.
7	Adjust VERTICAL POSITION (3) to display the image on the CRT.
8	Read the C/I on the CRT.

8.03 *XPD Measuring Procedure (MRTS II):* Connection and control settings are almost the same as in the co-channel C/I measurement, except for changing the SCAN WIDTH MHz (70) to ±32MHz.

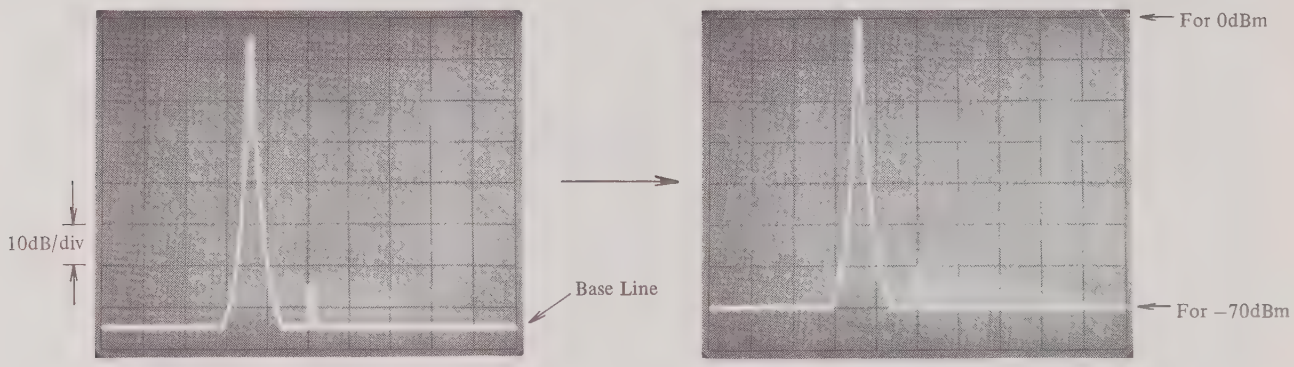


Fig. 20—Image Setting of VERTICAL POSITION (3), Example

8.04 A baseline appears when the IF input level is below −70dBm (when SCAN WIDTH is ±1MHz) or below −60dBm (when SCAN WIDTH is ±5, ±15, or ±32MHz). The baseline indicates the IF input level conversion for −70dBm (when SCAN WIDTH is ±1MHz) or −60dBm (when SCAN WIDTH is ±5, ±15 or ±32MHz).
Therefore, the absolute value of the spectrum can be read by setting the baseline at the second bottom division on the CRT screen.

8.05 CRT image information is always output from the RECORDER OUTPUT terminal (35).

8.06 ***Measured Result:*** In the normal microwave link, the XPD carrier-to-interference ratio is approx. 25dB–45dB, the co-channel C/I is approx. 60dB or more.

9. DC VOLTAGE MEASUREMENT

STEP	PROCEDURE
1	Push DIGITAL VOLTMETER (24).
2	Connect the Test Lead AA37 (A. No. 37) to the input terminals (25).
3	Connect the Test Lead AA37 to the Test Terminals.
4	Read the value on the DVM V display (17).

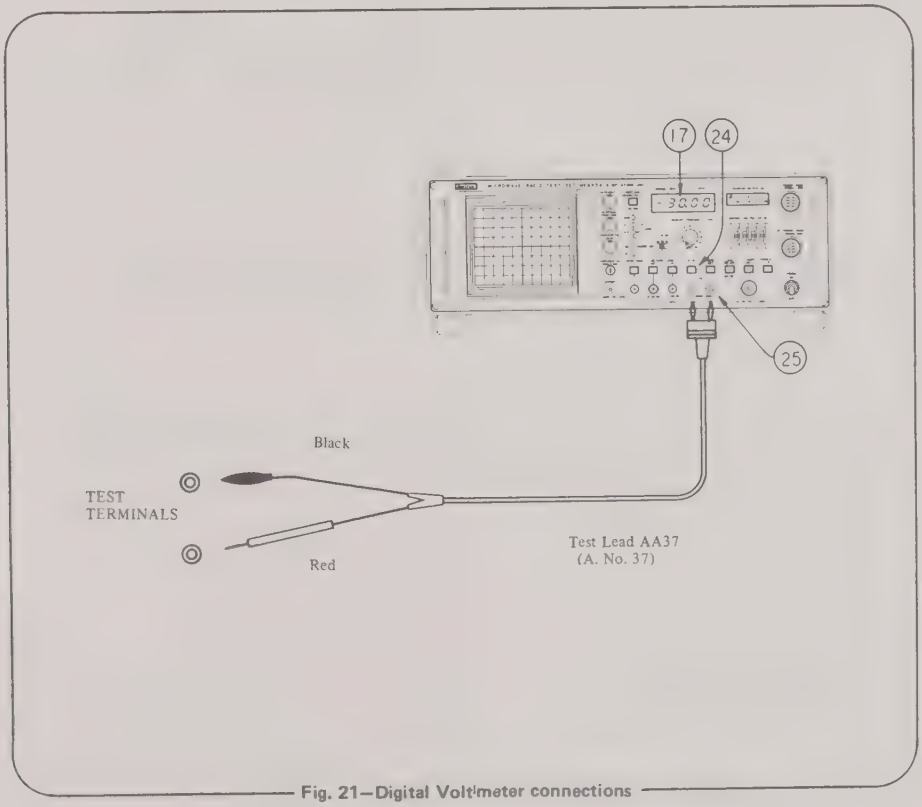


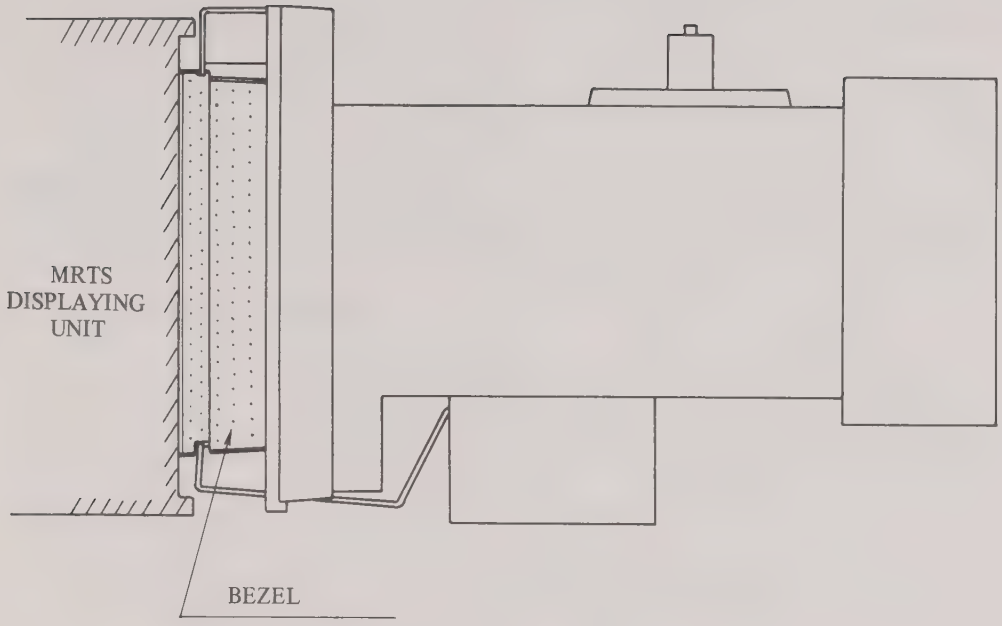
Fig. 21—Digital Voltmeter connections

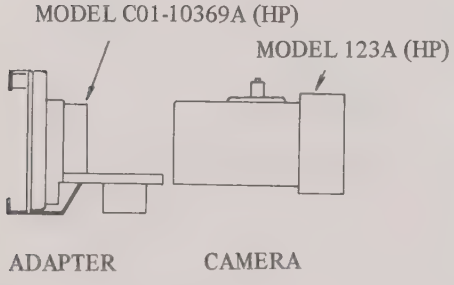
10. DATA RECORDING BY CAMERA AND X-Y RECORDERS

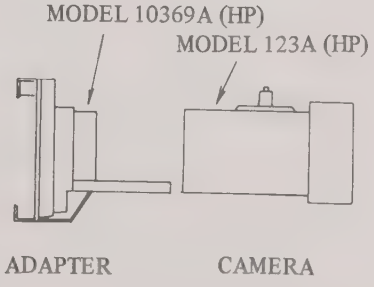
10.01 There are two ways to record measured results displayed on the CRT. One is to take a photograph and the other is to use an X-Y recorder. An X-Y recorder can be used only for recording the C/I measurements.

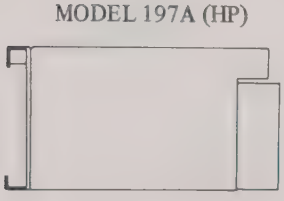
10.02 ***By Camera:***

STEP	PROCEDURE
1	Center the measured results on the CRT screen. (Check that the positions of the X-axis and Y-axis, SENSITIVITY, and MARKER are properly set.
2	Mount the camera on the bezel. See Fig. 22 for camera models and mounting diagrams.
3	Photograph as specified for the type of camera. (Set the shutter speed to 1, 1/2 or 1/4 sec.) Do not remove the film, and photograph the scale following Step 4.
4	Push HORIZONTAL (39) (Rear panel) INT ▬.
5	Push VERTICAL (41) (Rear panel) INT ▬.
6	Push DVM (24). After pushing the DVM (24) switch, the CRT screen brightens. The CRT scale can then be checked.
7	Push the shutter.
8	Remove the film. Remember that the film has been exposed twice (to the scale and measured results).









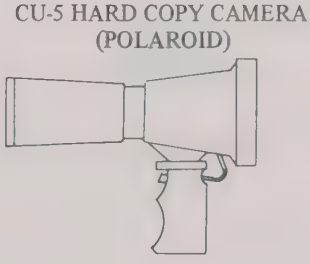


Fig. 22—Camera installation

10.03 *By X-Y Recorder:* The MRTS can be connected to the X-Y recorder for BASE BAND ANALYZER (manufactured by Scientific Atlanta Co.) for recording the results of C/I measurement.

The operating procedure is as follows:

STEP	PROCEDURE

1 Set the pen position to Point (A) (See Fig. 23) at the input voltage (X axis: 0V, Y axis: 0V) on a single X-Y recorder.

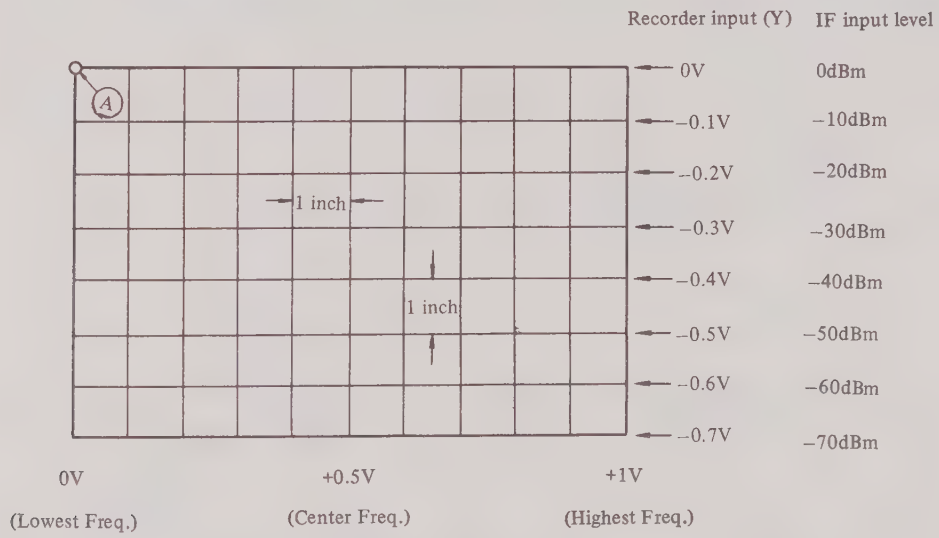


Fig. 23—Relationship Between Recording Paper and Data

2 Hold the pen in place by hand.

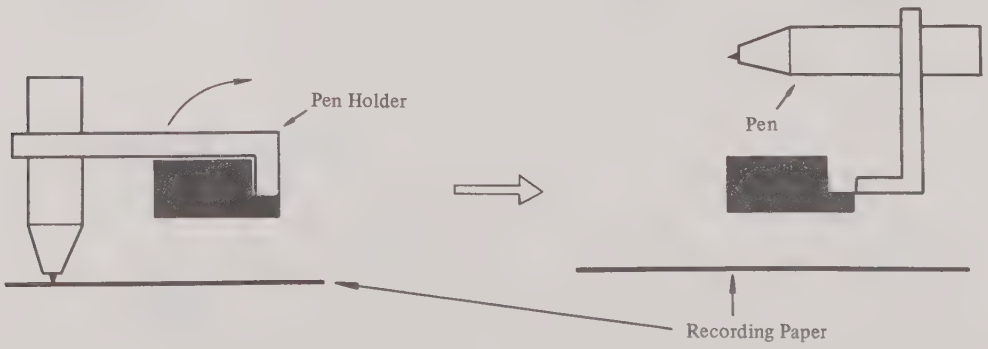


Fig. 24

STEP	PROCEDURE
3	Connect the MRTS RECORDER OUTPUT (35) (rear panel) to the X-Y recorder input. The relation between the MRTS spectrum input level, recording paper scale, frequency scan width and scale are shown in Fig. 23.
4	Check that the pen moves properly while holding. The sweep of the pen from left (lowest frequency) to right (highest frequency), takes approximately 300 seconds, while that from right to left takes only about 10 seconds.
5	Raise the pen by hand when it moves from right to left. Since the command from MRTS is 'Pen Lift', the tip of the pen does not touch the recording paper.
6	When the pen moves from left to right, it drops down and recording paper.
7	When the pen rises after recording is completed and moves from right to left, raise the pen by hand as described in Step 2.
8	Remove the recording paper from recorder.

11. EXTERNAL SIGNAL INPUT

11.01 The Displaying Unit has three external signal input on the rear panel for the vertical, horizontal deflection and blanking on the CRT.

11.02 When both VERTICAL (41) and HORIZONTAL (39) are set to EXT ⊥ , external signals are available for X-Y deflection on the CRT.

11.03 The sensitivity, maximum input voltage and input impedance of each connector are shown in Table E.

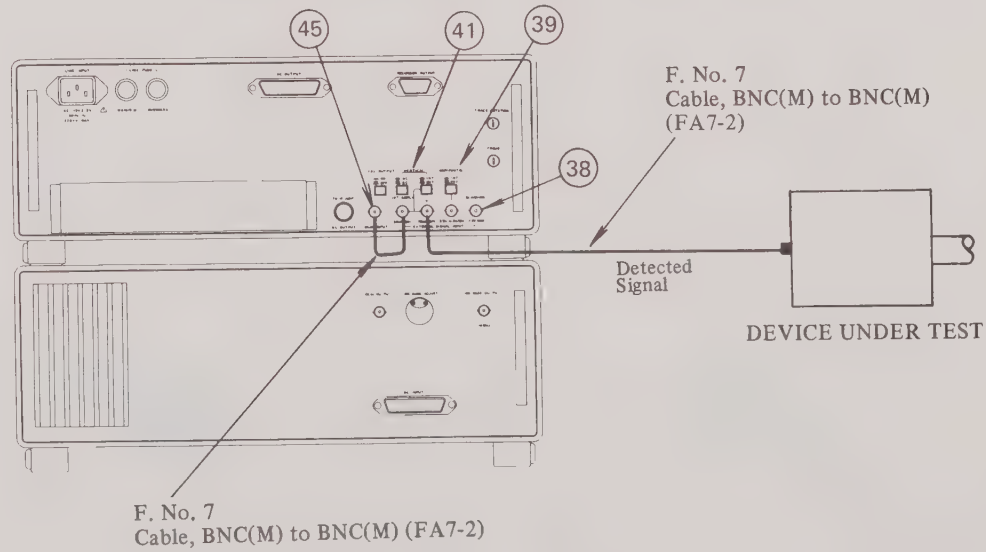
Table–E

EXTERNAL SIGNAL INPUT Connectors	Sensitivity	Maximum Input Voltage	Input Impedance
VERTICAL (41)	50mV/div	±7V	1MΩ
HORIZONTAL (39)	0.5V to 2V/div	±20V	1MΩ
BLANKING (38)	0V/unblank +3V/blank (TTL compatible)	±15V	1kΩ

11.04 *Use of VERTICAL (41) :*

The VERTICAL (41) connectors are the balanced type. Therefore, when these connectors are used, the other side should be terminated with a load impedance of less than 1kΩ. If a load greater than this is applied, the high input impedance of the VERTICAL connectors may cause noise on the CRT.

The LOCAL INPUT (45) connector is available for low impedance termination of less than 1kΩ. This is shown in Fig–25.



LOCAL INPUT (45) : Input impedance . . . . . Less than 1kΩ

Fig.–25 Example of Low Impedance Termination VERTICAL (41)

SECTION 4

BLOCK DIAGRAM

CONTENTS PAGE

1. SENDING UNIT 4-2

2. DISPLAYING UNIT 4-3

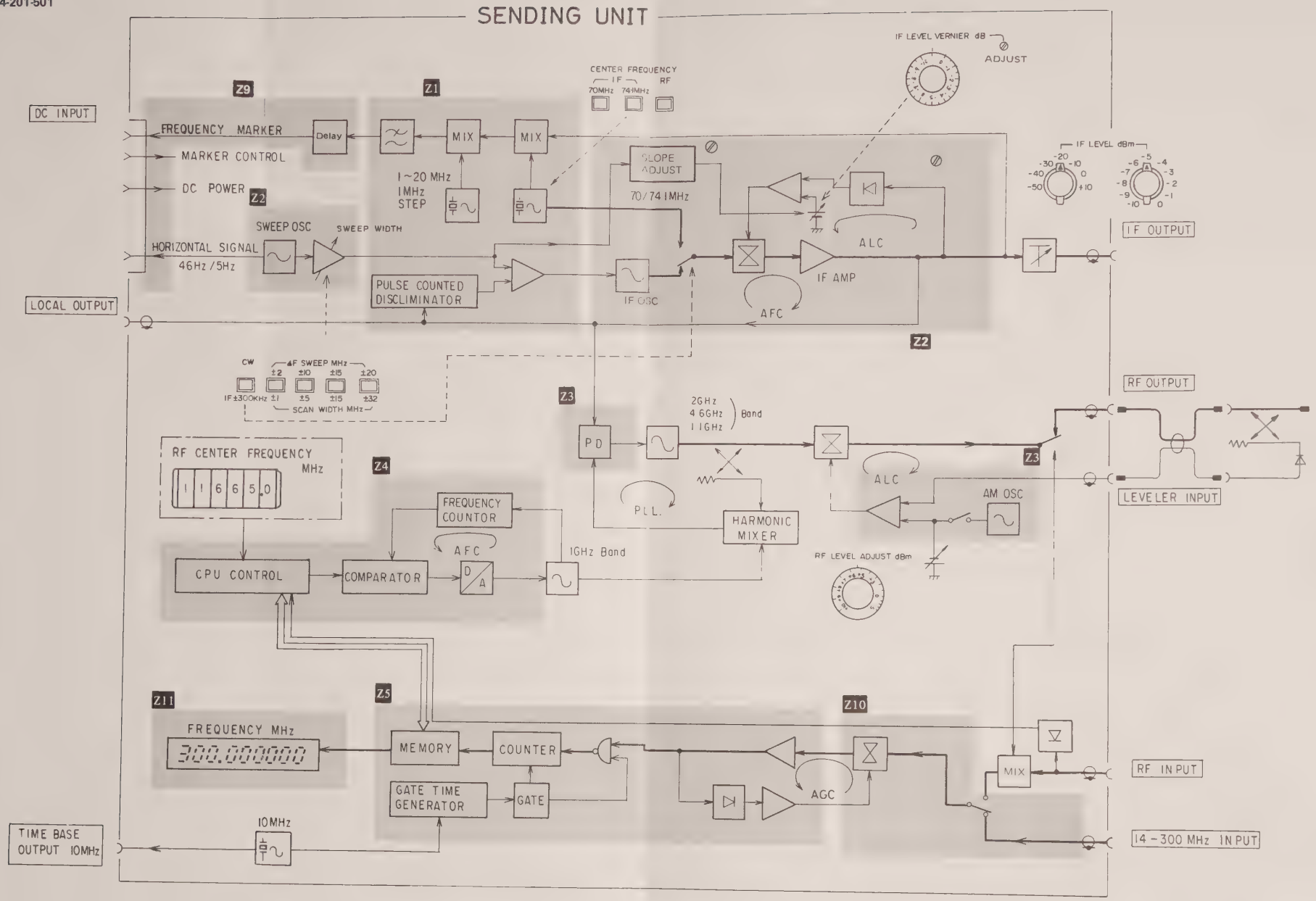


Fig. 1–BLOCK DIAGRAM OF MICROWAVE RADIO TEST SET (1/2)

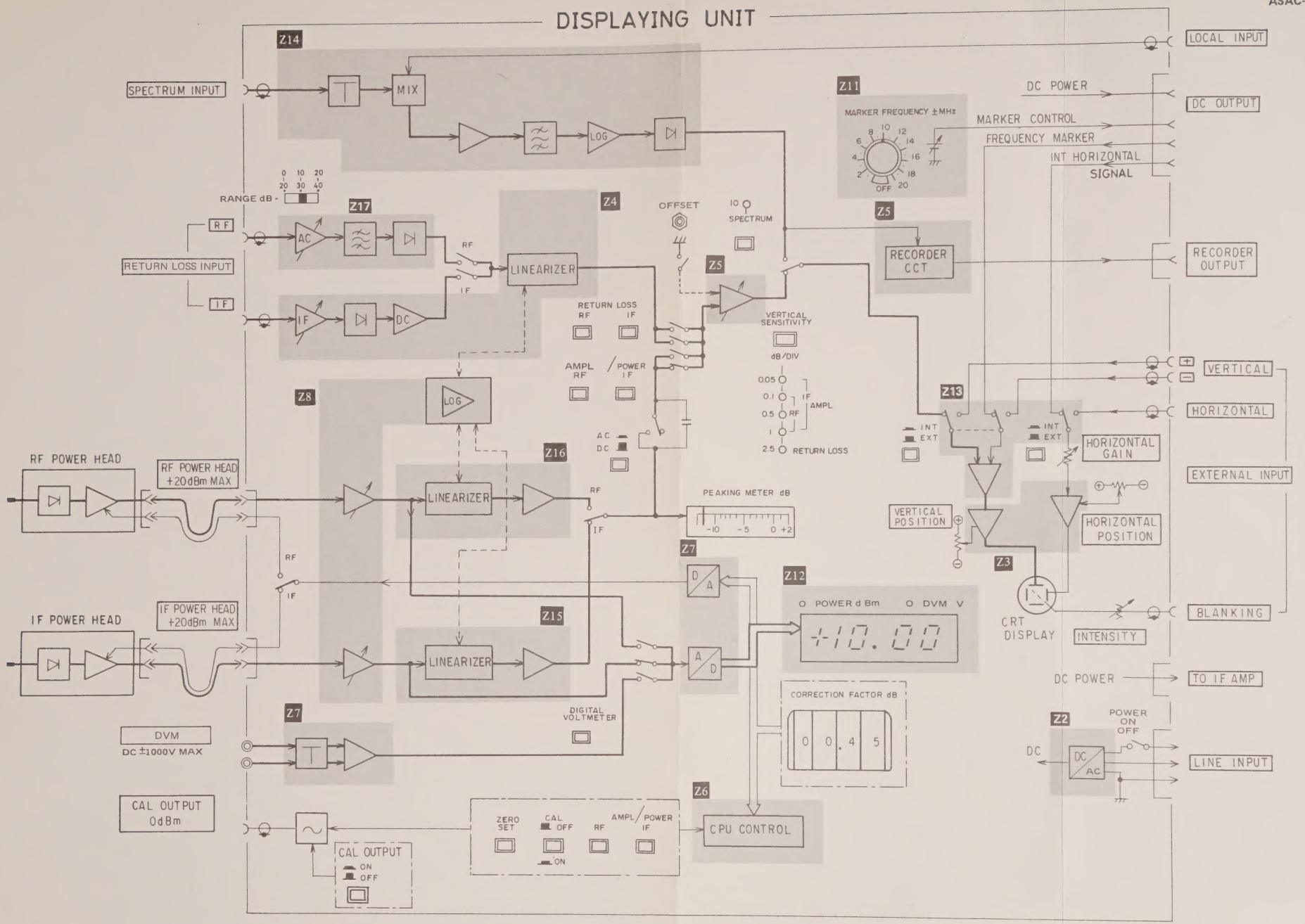


Fig. 1–BLOCK DIAGRAM OF MICROWAVE RADIO TEST SET (2/2)

MP MASTER
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